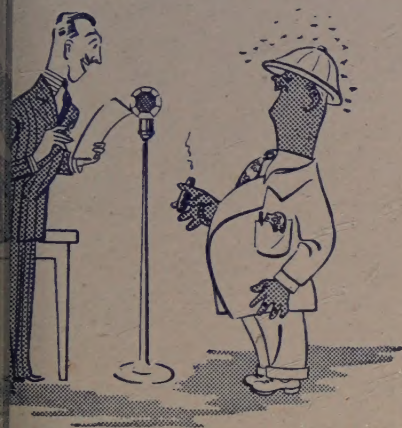


UIZ No. 4

Next question,
Bigtiffin... How do
the engineering sahibs
get about solving their
corrosion problems in
the tropics?"



Bigtiffin squared up to the microphone with the
a man shouldering the white man's entire burden.
have been out East 35 years," he said. "I have
in swamps that wanted draining and jungles that
to be cleared, and wherever I've built, I have had
tack on with conditions of heavy rains five months
of twelve. Corrosion has always been one of our
st bugbears, and it wasn't until a few years ago
discovered a satisfactory method of dealing with
Metal Coatings. That's what we use nowadays.
ved in situ by the British wire process."
t how do you spray it?" asked the announcer.
h a Metallisation Pistol," replied Mr. Bigtiffin
atically. "That Pistol has meant as much to us
5" gun to the Navy."



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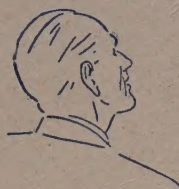
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METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 15

JULY 1948

Part 11

I.—PROPERTIES OF METALS

***Preparation of Thin Specimen Films [of Beryllium and Aluminium].** Nils East (*Nature*, 1947, 159, (4037), 370–371).—A letter. Films of beryllium of 20 Å thickness, and of aluminium of 12 Å thickness, have been prepared by depositing the metal from vapour on films of cellulose nitrate, which is subsequently dissolved away. Diatoms may be transferred to these films and then examined with an electron microscope.—M. A. V.

***Cæsium Chromate Photo-Tube Pellets [Reduction of Cæsium Chromate by Silicon, Titanium, or Zirconium].** H. A. Liebhafsky and A. F. Winslow (*J. Appl. Physics*, 1947, 18, (12), 1128–1132).—Pellets which supply cæsium for the light-sensitive surface in photo-electric cells can be made from a compressed mixture of cæsium chromate and a reducing agent, the metal being liberated by the induction heating of the pellet until reaction commences. Experiments were made to discover the conditions of max. yield of cæsium when silicon, titanium, or zirconium were the reducing agents. A method of measuring the yield, by reaction of the cæsium with water vapour, and the measurement of the hydrogen evolved, is described. The results were erratic, but zirconium appears to be a less-effective reducing agent than titanium or silicon.—D. W. W.

***Crystalline Aggregation of Cobalt Powder.** J. T. McCartney and R. B. Anderson (*J. Appl. Physics*, 1947, 18, (10), 902–903).—A note. During reduction of cobaltous oxide to cobalt by hydrogen at 250° C., the cobalt particles aggregated into hexagonal platelets 7–25 μ in dia. X-ray diffraction analysis showed that the crystal phase was hexagonal cobalt. The possible explanation is advanced that the aggregates are formed by forces similar to those operating in normal crystal formation, but of reduced magnitude.—D. W. W.

***Strain Sensitivity of Magnetic Susceptibility [in Copper and Aluminium].** C. S. Hutchison and James Reekie (*Phys. Rev.*, 1948, [ii], 73, (5), 517–518).—The change of magnetic susceptibility of copper and aluminium was studied, at room temp., as a function of the degree of cold working, introduced by wire drawing. For copper, the diamagnetic susceptibility rapidly decreases (numerically), becoming const. at 15% below the value for annealed metal after 10% cold work. After 40% cold work the value rises again towards the "annealed" value. For aluminium, the susceptibility decreases more slowly, reaching a stable value 15% below the "annealed" value at 50% reduction in area. The results are interpreted in terms of the lattice distortion and grain fragmentation which cold work introduces. Magnetic self-recovery is shown by copper as a result of the recovery from lattice distortion; no such recovery is shown by aluminium because this metal recovers from lattice distortion during working. The remaining stable change in susceptibility is due to fragmentation. The rise in the susceptibility–cold work curve for copper at 40% cold work is due to spontaneous recrystallization at room temp. In agreement with these ideas, the major part of the stable change in

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

susceptibility is confined to the most severely fragmented surface layers of the metal. Such changes cannot be attributed to ferromagnetic impurities.—G. V. R.

***Emission of Secondary Electrons from Nickel and Molybdenum by Neutrons and Atoms of Mercury and Potassium.** Rafi Mohammed Chaudhri and Abdul Wahid Khan (*Nature*, 1947, **159**, (4032), 202).—Beams of mercury atoms, of energy 1200–2500 V., and potassium atoms of energy 1200–2000 V. were directed on to nickel and molybdenum targets, and the secondary emission was measured. It was greater for a dirty target surface than a well-degassed surface, and the energy distribution Maxwellian, corresponding to effective temp. of 29,000°–45,000° K.—M. A. V.

***Temperature Coefficient of Electrical Resistivity for Crystalline Selenium Containing Various Percentages of Bromine.** Wayne E. Blackburn (*Phys. Rev.*, 1947, [ii], **71**, (4), 277).—Brief abstract of a paper presented to the American Physical Society. The temp. coeff. of electrical resistance of brominated selenium over the range -30° to 100° C. was found to be negative and variable. The electrical resistivity of the selenium samples varied by factors of 3 to 12 for the temp. range mentioned, depending on the bromine content. A reproducible hysteresis loop was obtained on the plot of resistivity *versus* temp. A minimum in the plot of electrical resistivity *versus* bromine content was found with 0.007% bromine in selenium. Activation energies for freezing electrons, obtained from the slopes of conductivity *versus* temp. plots, indicate a dependence on bromine content in the selenium.—AUTHOR.

***The Effect of Annealing and Gas Content on the Supraconducting Properties of Tantalum.** Robert T. Webber (*Phys. Rev.*, 1947, [ii], **72**, (12), 1241–1244).—Using three samples of tantalum wire (cold rolled, swaged, and drawn down to a dia. of 0.0039 in., and annealed *in vacuo* at 1000° C.) the effects of high temp. annealing and gas content on the supraconducting transition temp. and critical fields were studied. Annealing at 2200° – 2500° C., continued until the room-temp. electrical resistance was a minimum, raised the transition temp. from 4.156° to 4.32° K., and lowered the initial slope of the critical magnetic field from 1360 to 600 gauss per $^{\circ}$ C. Much sharper transitions were observed for the annealed specimens. The effect of gas absorption, by heating in air at a pressure of 10^{-3} mm. mercury (1200° C.), was slight. The influence of the specimen current on the critical field was studied, and the results are discussed.—G. V. R.

***The Adsorption of Hydrogen on Tungsten Powders.** George Halsey and Hugh S. Taylor (*J. Chem. Physics*, 1947, **15**, (9), 624–630).—An analysis is made of the extensive experimental data of Frankenburg on the adsorption of hydrogen by metallic tungsten powder between -194° and $+750^{\circ}$ C., the method used being the Fowler–Guggenheim treatment of adsorption phenomena. It was not found possible to interpret the data in terms of interaction between the adsorbed species on a uniform adsorbent surface.—A. I. V.

***Energy Distribution of Photo-Electrons from Polycrystalline Tungsten.** Apker, E. Taft, and J. Dickey (*Phys. Rev.*, 1948, [ii], **73**, (1), 46–50).—By applying retarding potentials to spherical collectors, total-energy distributions of the photo-electrons from tungsten were determined. The emitter specimens were $99.9 \pm$ % pure tungsten ribbons, 0.25 cm. wide, 2.5 cm. long, and 0.001 cm. thick. Ageing treatments were given to preserve almost unaltered the original rolling texture, with [100] directions within 10° of the perpendicular to the ribbon surface. Average crystal diameter was 0.005 cm. The results are presented graphically and discussed. Energy distribution functions increase linearly with energy, and the average work-function is 4.49 eV., in agreement with data determined by other methods.—G. V. R.

***The Lattice Strength of Crystals and Metals as a Definite Fraction of the Elastic Modulus.** J. Bingel (*Arch. Metallkunde*, 1947, 1, (7/8), 300–304).—Using Madelung's lattice-potential and Born's electrostatic-potential methods, the tensile strength R of the ideal atomic lattice of face-centred cubic crystals is a definite fraction of the elastic modulus E . With an elongation at fracture

ϵ of 23%, $\frac{R}{E} \cong \frac{1}{12}$. Thus, if the elastic modulus of copper is taken as 10,000

kg./mm.², the tensile strength of the ideal atomic lattice, calculated by this method, is 835 kg./mm.², as compared with a tensile strength of 20 kg./mm.² obtained by tests on high-purity copper.—E. N.

***The Thermodynamics of Irreversible Processes. IV.—The Theory of Elasticity and Anelasticity.** Carl Eckart (*Phys. Rev.*, 1948, [ii], 73, (4), 373–382).—Theoretical. The fundamental physical basis of elasticity and anelasticity is considered, and it is shown that the mathematical development contains some questionable assumptions. A new development is presented, in which some of the unsatisfactory features of previous treatments are eliminated.—G. V. R.

***Mechanical Behaviour of High-Damping Metals.** Clarence Zener (*J. Appl. Physics*, 1947, 18, (11), 1022–1025).—Z. deduces the relationship between two of the most commonly used measures of the internal friction of metals, logarithmic decrement and tangent of the angle with which strain lags behind stress. He further describes the conditions under which a metal will not vibrate, but return aperiodically to equilibrium.—D. W. W.

Statistical Theory of the Elementary Process of Plastic Deformation. W. James Lyons (*Phys. Rev.*, 1948, [ii], 73, (4), 413–414).—A brief exposition of a mathematical framework, developed along statistical lines, into which more descriptive theories of the elementary processes of creep and other deformation phenomena may be built. The basic assumptions in the method are discussed.—G. V. R.

***The Flow of Metals Under Various Stress Conditions.** A. L. Nadai (*Proc. Inst. Mech. Eng.*, 1947, 157, (28), 121–160).—James Clayton Lecture. A mathematical treatment of the phenomena associated with the permanent deformations of metals. Engineering methods for dealing with finite strains are reviewed and certain new types of strains that offer possibilities for expressing the stress-strain relations required for this work are introduced; the creep of metals at elevated temp. is mentioned. Experimental work carried out on the flow of copper is described, and a bibliography of 75 references is included.—W. A. M. P.

Numerical Calculation of the Strain-Hardening During Cold Stretching and Cold Compression. H. Brandenberger (*Schweiz. Arch. angew. Wiss. Techn.*, 1947, 13, (8), 232–238; (9), 268–275).—[In German]. In a mathematical treatment, B. calculates the tri-axial "space" and "lattice" stresses induced in a body strained in tension or compression, and shows that internal space and lattice stresses may exist in a body in the absence of any externally applied forces. These internal stresses cause the yield point to be raised, during tensile or compressive straining, to a value (for steel) 54% above the true elastic limit; the yield point in compression is similarly reduced to 54% below the true elastic limit by prior straining in tension. The value of the elastic limit (54% below the yield point) exactly corresponds with the fatigue limit. B.'s treatment enables a calculation of the Bauschinger effect to be made. The treatment is confirmed by the results obtained with brass by Masing and Mauksch, and it explains the increase in the elastic limit found by Kuntze and Sachs when investigating the Bauschinger effect in copper. A new explanation for fatigue phenomena is advanced.—R. W. R.

***A Note on the Theory of Dislocation in Metals.**—W. R. Dean and A. H. Wilson (*Proc. Camb. Phil. Soc.*, 1947, 43, (2), 205–212).—A mathematical

contribution to dislocation theory using a simple model of the Bragg type. An expression is derived for the energy of a pair of dislocations in terms of the distance between them. On simplification, this energy $E = \frac{\mu S^2}{\pi} \log t/R$, where μ is the appropriate elastic constant, S is the slip distance, t is the distance apart of the dislocations, R is the arbitrary radius of the transition region at the centre of each dislocation, which is excluded to avoid stress terms rising to infinity. On the basis of Bragg's work, t is taken to be 10^{-5} , $S = 2.6 \times 10^{-10}$ (for copper) $= 4.5 \times 10^{11}$ (C.G.S. units), so that an order of magnitude of E is derived. By equating the total energies of dislocations to the maximum energy density that Taylor and Quinney found could be imparted to copper by cold work (43×10^7 C.G.S.), D. and W. found that the number N of dislocations per unit length on an interface between two mosaic elements is 0.9×10^7 . Bragg's estimate from a two-dimensional model is given as something in excess of 1.7×10^7 .—M. B. W.

On the Pressure-Volume and Pressure-Compressibility Relation of Metals. P. Gombás (*Phys. Rev.*, 1947, [ii], 72, (11), 1123-1124).—A letter. The statistical theory of the metallic bond in the alkali and alkaline-earth metals developed by G. is extended to cover calculations of the pressure-volume relationships of sodium, potassium, and rubidium at high pressure, for comparison with the experimental results of Bridgman at pressures up to 10 kg./cm.² at a temp. of 296° K. Agreement is satisfactory, since even at these high pressures the electron clouds of neighbouring ions do not overlap. The pressure-compressibility relationships at 0° K. are also calculated for the alkali and alkaline-earth metals, and are summarized graphically.—G. V. R.

***Mechanism of Fracture of Glass and Similar Brittle Solids.** Nelson W. Taylor (*J. Appl. Physics*, 1947, 18, (11), 943-955).—The relation between the stress to break a brittle material in simple tension and the time of application of the stress is discussed in terms of a theory which considers that the atomic network of the material undergoes re-arrangement under the applied stress. The effect of the chemical environment is discussed. The application of this theory to glass, organic resins, and the stress-corrosion of metals is considered.—D. W. W.

A Model which Shows Hardening and Annealing Mechanisms. Edwin C. Davis (*Metal Progress*, 1947, 51, (2), 248-249).—D. shows how the behaviour of small lead shot in a watch-glass can be used to represent the processes of slip, slip interference, cold work, and annealing.—N. B. V.

***The Conductivity of Metals at Micro-Wave Frequencies.** B. Serin (*Phys. Rev.*, 1947, [ii], 72, (12), 1261-1262).—A letter. It is shown that the free electron theory may be applied to the problem of metallic conductivity at metals at micro-wave frequencies, to give information about the temperature dependence of radio-frequency conductivity. The theoretical relationship of the radio-frequency conductivity with the D.C. conductivity is shown for silver. The results are in qualitative agreement with experimental results for lead.—G. V. R.

***Excess-Defect Semi-Conductor Contacts.** L. Sosnowski (*Phys. Rev.*, 1947, [ii], 72, (7), 641-642).—Referring to the properties of silicon-germanium rectifiers, in which impurity centres give rise to both excess and defect conductivity, it is reported that lead sulphide shows an analogous distribution of levels, the metallic centres being connected with excess lead, and the electro-negative centres with oxygen impurity. A thin layer exhibits photo-voltaic and rectifying properties not associated with a contact with metallic electrodes.—G. V. R.

***Excess-Defect Germanium Contacts.** S. Benzer (*Phys. Rev.*, 1947, [ii], 72, (12), 1267-1268).—A letter. Referring to the work of Sosnowski (see preceding abstract), it is shown that the photo-voltaic and rectification effects

reported for lead sulphide occur also for germanium. The effects are described and discussed.—G. V. R.

***Supraconductivity and the Debye Characteristic Temperature.** K. R. Dixit (*Phys. Rev.*, 1948, [ii], **73**, (2), 182–183).—Cf. *Met. Abs.*, this vol., p. 181. It is pointed out that the relationship between the supraconducting threshold temp. T_s and the Debye characteristic temp. θ_D implies that substances which do not become supraconducting by about 0.7° K. will not become supraconducting at all. The implication is briefly discussed.—G. V. R.

II.—PROPERTIES OF ALLOYS

Selecting Aluminium Alloys for Specific Applications. Herbert Dobkin (*Steel*, 1947, **121**, (25), 67–70).—The composition, properties, and uses of common wrought Al–Mn, Al–Mg, Al–Mg–Si, Al–Cu–Mg–Mn, Al–Cu–Mg–Zn, Al–Cu–Mn–Si, and Al–Cu–Mg–Ni alloys are given.—M. A. V.

***The Influence of Chemical Composition and Quality of Raw Materials on the Physical Properties of Silumin–Gamma.** [—II]. Vlad. Zednik (*Metallurgia*, 1948, **37**, (221), 253–257).—Cf. *Met. Abs.*, this vol., p. 330. The effect of substituting manganese for cobalt was to lower the tensile strength and elongation slightly. A series of comparative tests on manganese- and cobalt–Silumin–Gamma, prepared in each case from French and German materials, is reported. There was a certain amount of scatter of results, but, in general, French raw materials yielded a superior product. Metallographic tests confirmed that cobalt compensated for the bad effects of iron better than manganese.—M. A. V.

***Stretching Characteristics of Aluminium Alloy Sheet.** (Taub). See p. 538.

Bearing Failures—Causes and Cures. R. W. Dayton and R. C. Adams (*Machine Design*, 1946, **18**, (5), 113–116).

Permanent-Magnet Alloys. Earl M. Underhill (*Electronics*, 1948, **21**, (1), 122–123).—A table is presented giving magnetic, physical, and mechanical data for 42 permanent magnet alloys. The metals included in the table are the common magnet steels, alloys of the Alnico series, Cu–Ni–Co, Cu–Ni–Fe, Co–Mo–Fe, Ag–Mn–Al, Va–Fe–Co alloys, the magnetic platinum metals, an Al–Ni–Co–Ti–Fe alloy, and a material composed of a sintered mixture of iron and cobalt oxides. Additional notes describe the normal methods of manufacture of permanent magnets from the various materials.—D. M. L.

***The Efficiency of Thermo-Electric Generators.—I.** Maria Telkes (*J. Appl. Physics*, 1947, **18**, (12), 1116–1127).—T. considers the generation of electrical energy from thermal energy by thermo-electric means. Theoretical efficiency calculations give a relationship between the operating temp. difference, the thermo-electric power, and the specific thermal and electrical conductivities. High efficiencies are only obtained with materials of high thermo-electric power, high specific electrical conductivity, and low specific thermal conductivity. The calculated and observed efficiencies of a number of alloy thermocouples were in good agreement. Efficiencies of 4.2% were obtained with a couple consisting of zinc–antimony and bismuth–antimony alloys, using an operating temp. difference of 230° C. Certain semi-conductors had high thermo-electric power; a thermocouple of PbS containing excess lead with a zinc–antimony alloy gave an efficiency of 7%.—D. W. W.

III.—STRUCTURE

(Metallography ; Macrography ; Crystal Structure.)

[For all abstracts on the constitution of alloy systems, including X-ray studies, see II.—Properties of Alloys.]

Difficult Metallographic Mounts : Mounting [Aluminium Alloys] for Ed Examination. Andre Hone (*Metal Progress*, 1947, **51**, (3), 435–437).—After thorough cleaning in acetone, the specimen is given four coatings of a proprietary adhesive and then mounted in polystyrene. It is then polished and examined in the usual way. The adhesive serves to prevent the formation of a gap between the specimen and the mount and thus preserves the edge of the specimen. This method of mounting is particularly useful when anodized or corroded aluminium specimens have to be examined.—N. B. V.

***Instantaneous Rates of Grain Growth [Aluminium].** Paul A. Beck, M. I. Holzworth, and Hsun Hu (*Phys. Rev.*, 1948, [ii], **73**, (5), 526–527).—The isothermal increase of the average instantaneous grain-size D with annealing time t in high-purity aluminium follows the relation $D = Kt^n$, where K is a constant for a given temp. and n increases from 0.056 at 350° C. to 0.32 at 600° C. After 33% reduction in area by rolling, the rate of grain growth depends only on the instantaneous grain-size and the temp., and not on the particular prior heat-treatment used to produce this grain-size. It is shown that $\log \frac{dD}{dt}$ plotted against $\log D$ gives a straight line for each temp. with a slope of $\left(1 - \frac{1}{n}\right)$, and the rate of decay $\frac{dD}{dt}$ increases considerably with decreasing temp.

The variation of slope with temp. shows that the ratio of the instantaneous rates of growth at two different temp. depends on grain size. Thus the heat of activation for the process is also grain-size dependent. Strictly speaking, no heat of activation is derivable for the process as a whole. The numerical results are presented graphically and discussed.—G. V. R.

Grain Growth in Alpha Brass. J. E. Burke (*J. Appl. Physics*, 1947, **18**, (11), 1028).—A letter. B. discusses the results on isothermal grain growth in α brass of Walker (*Univ. Illinois Eng. Exper. Sta. Bull.*, 1945, (359); *Metal Abs.*, 1946, **13**, 293) and shows that these results are consistent with a activation energy for the process of 60 kilocal./mol., and that the data fit the relationship $D - D_0 = kt^n$, where D is the grain-size and D_0 the grain-size at the time of recrystallization. Cf. abstract below.—D. W. W.

Comments on "Grain Growth in Alpha Brass". Paul A. Beck (*J. Appl. Physics*, 1947, **18**, (11), 1028–1029).—A letter. Cf. preceding abstract. B. criticizes the note by Burke, and suggests an alternative expression for grain growth.—D. W. W.

Notes on Polishing Technique : Polishing of 0.60 Carbon Steels. C. Patricia Kenyon (*Metal Progress*, 1947, **51**, (2), 260–261); **Attack Method for Preparing Tungsten.** Harry W. Woods (*ibid.*, 261–263).—For tungsten, W. has evolved a new technique in which polishing and most of the etching are done simultaneously. The specimen is taken directly from No. 0 emery paper to the polishing wheel which is moistened with a cold suspension of polishing medium plus etchant (3.5 g. $K_4Fe(CN)_6$, 1 g. NaOH, 150 c.c. distilled water). The specimen is polished on the freshly wetted wheel for approx. 15 sec., rinsed in water, dipped in the etchant alone for 5 sec., again rinsed, and dried. The method is quicker than the older ones and the microstructure obtained is less likely to be obscured by fictitious pseudo-structures.—N. B. V.

***Fractographic Structures in Zinc.** Carl A. Zapffe (*Metal Progress*, 1947, **51**, (3), 428–431).—Cast zinc of high purity was fractured and examined by the

technique previously described (*Trans. Amer. Soc. Metals*, 1945, **34**, 71; *Met. Abs.*, 1945, **12**, 80). The results show that zinc fractures in a similar manner to bismuth (*Metal Progress*, 1946, **50**, (2), 283; *Met. Abs.*, 1947, **14**, 50).

—N. B. V.

To Avoid Staining Around Cracks. Victor Kappel (*Metal Progress*, 1947, **51**, (1), 85–86).—To avoid staining of welded sections while photomicrographs are being taken, due to etchant seeping out of cracks or cavities, K. suggests that the photography be carried out with the specimen under water in a shallow beaker.—N. B. V.

***Oxide Films Formed on Alloys at Moderate Temperatures: Electron-Diffraction and Electron-Microscope Study.** Earl A. Gulbransen, R. T. Phelps, and J. W. Hickman (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (10), 640–652).—Electron-microscope and electron-diffraction data are given for electrochemically and chemically stripped films from alloys consisting principally of iron, cobalt, nickel, and chromium, e.g. stainless steel, Inconel, Nichrome, Kovar, and chromium-iron, nickel-iron, and cobalt-iron alloys. Reflection and transmission methods of electron diffraction were used. From the electron-diffraction results it is concluded that iron and chromium ions diffuse more readily to the surface of the oxide film than other metal ions; stratification of the oxides occurs even for films 100–300 Å thick; Cr_2O_3 always occurs in refractory films, and where there is stratification Cr_2O_3 is in contact with the sub-stratum; NiO is never observed in the surface of the oxide film although in certain cases it occurs in the body of the film; two simple oxides may form a spinel-type oxide by solid-phase reaction; with the exception of iron and chromium, metals which constitute $>5\%$ of the alloy do not occur as simple oxides on the outer surface of the film, but appear to form spinels in the body of the film; simple oxides of cobalt, manganese, silicon, vanadium, and tungsten are not formed. Electron-microscope studies showed that thin oxide films consist of a continuous oxide film having crystals 100–1600 Å in size; the oxide films are not of uniform density and the crystals are of irregular shape; a longer oxidation period increases the crystal size; crystals formed on non-protective alloys, e.g. mild steel, at 250° C. are the same size as those formed on protective alloys at 600° C.; at a given temp. a correlation may exist between the size of crystal and the protective properties of the film; the thickness of the boundary zone between crystals in the mosaic structure is of the order of 50 Å, or within the resolving power of the microscope.—F. M. L.

***Electron-Microscope and Electron-Diffraction Study of Slip in Metal Crystals.** R. D. Heidenreich and W. Shockley (*J. Appl. Physics*, 1947, **18**, (11), 1029–1031).—A letter. Slip bands in single crystals of pure aluminium were investigated by the electron microscope, and by electron-diffraction methods. The slip bands observed in the light microscope are shown to be laminar regions, the laminae being about 200 Å thick, by electron microscopy. Electron-diffraction experiments showed that the lattice distortion was confined almost entirely to the slip bands, very little occurring in the remainder of the crystal.—D. W. W.

On the Structure of Grain Boundaries in Metals. T'ing-Sui Kê (*Phys. Rev.*, 1948, [ii], **73**, (3), 267–268).—Internal friction and related effects show that the transition region between adjoining grains behaves in a viscous manner in so far as it cannot permanently sustain a shear stress and has a coeff. of viscosity decreasing with an increase of temp. The activation energy associated with grain-boundary slip in α brass is close to that for the diffusion of zinc in α brass of the same composition. The activation energies for grain-boundary slip in α iron and aluminium agree with the values for self-diffusion. Grain-boundary slip, therefore, involves the same mechanism as volume diffusion, so that, at least as far as the local order is concerned, the structure

of the transition region at the grain boundary cannot be markedly different from that of the interior of the grains. Grain-boundary slip is thus creep on a microscopic scale. Creep occurs at a lower temp. than creep in single crystals because of the disturbed crystallinity at the grain boundary. The boundary region within which such creep occurs must have a width of at least a few atomic diameters.—G. V. R.

Stereoscopic Drawings of Crystal Structures. W. L. Bond (*Amer. Mineralogist*, 1947, **32**, 454-461; and *Bell Teleph. System Tech. Publ.* **B-1538**, 1947, 8 pp.).—A method is presented for getting stereoscopic pairs of atomic structure views given the co-ordinates of the atoms and cell constants.

—S. G.

***Divergent-Beam X-Ray Photography of Metallic Single Crystals.** A. H. Geisler, J. K. Hill, and J. B. Newkirk (*Phys. Rev.*, 1947, [ii], **72**, (10), 983-984).—A letter. Using widely divergent X-ray beams, a pattern of fine white absorption lines and black diffraction lines on a grey background is produced. The patterns may be used for determinations of crystal orientation, lattice constants and crystal perfection. The same effect may be produced by a collimated beam from a sealed-off X-ray tube with a copper target, used in conjunction with a transmission Laue camera on specimens of alloys containing iron or cobalt. The required divergency originates at the specimen as secondary Co or Fe radiation which is excited by the incident beam. Specimen diffraction patterns, which by this method include Laue spots, are reproduced and discussed. Advantages, disadvantages, and possible developments of the technique are reviewed.—G. V. R.

What Chemistry Owes to X-Rays. Kathleen Lonsdale (*Nature*, 1947, **159** (4035), 285-287).—Summary of lectures delivered to the Royal Institution on 5 and 12 Dec. 1946. The applications of X-rays to chemical research, from Von Laue's experiment in 1912 to the present day, are reviewed.—M. A. V.

X-Ray Wave-Length Standards. Elizabeth Armstrong Wood (*Phys. Rev.*, 1947, [ii], **72**, (5), 436-437).—A letter calling attention to the announcement by the X-Ray Analysis Group of the Institute of Physics (July 1946) that agreement had been reached on a factor of 1.00202 (correct to 0.003%) for converting measurements in kX. units to Ångström units.—G. V. R.

The Conversion Factor for kX. Units to Ångström Units. Elizabeth Armstrong Wood (*J. Appl. Physics*, 1947, **18**, (10), 929-930).—A letter. W. call attention to a note by Bragg (*J. Sci. Instruments*, 1947, **24**, (1), 27; *Met. Abs.* 1947, **14**, 237).—D. W. W.

V.—POWDER METALLURGY

Manufacture and Application of Sintered Carbides. I.—Production and Properties. E. M. Trent. **II.—Application in Industry.** H. Eckersley (*J. Inst. Prod. Eng.*, 1947, **26**, (10), 349-377; and (summaries) Part I, *Metal Ind.*, 1947, **71**, (25), 499-502; *Iron and Steel*, 1947, **20**, (13), 550-552, 626 *Mech. World*, 1947, **122**, (3172), 445-448; Part II, *Metal Ind.*, 1947, **71**, (26), 521, 523; *Iron and Steel*, 1947, **20**, (14), 645-647; *Mech. World*, 1947, **122**, (3173), 475-477; *Engineer*, 1947, **184**, (4787), 396-397; (4788), 420-422).—(I.—) A general account is given of the structure, manufacture, and properties of cemented tungsten carbides with and without titanium carbide. (II.—) Typical lathe tools, milling cutters, slot-drilling cutters, rolls for flattening and forming round wire, and press tools for blanking and piercing are illustrated and their design and application discussed.—J. C. C.

Fernico from Metal Powders. E. E. Burger (*Gen. Elect. Rev.*, 1946, **49** (12), 22-24; and (summary) *Nickel Bull.*, 1947, **20**, (3/4), 46).—B. describes the production and the uses of Fernico, an Fe-Ni-Co alloy used for glass

metal seals as its thermal-expansion coeff. coincides with that of a commercially available glass. The material has a heat conductivity only 4% of that of copper. The main methods of production are melting and sintering. The alloys produced by the latter method show improved properties. An electronic control system for the sintering furnace is described.—D. M. L.

1 ***The Moment of Active Deformation [in Hot-Pressing Metal Powders].** Harry L. Strauss, Jr. (*Metal Progress*, 1947, 51, (2), 254–255).—In the hot-pressing of powdered metal compacts, at a suitable combination of temp. and pressure the material undergoes a marked increase in density in a very short time; this is known as the moment of active deformation. Tests show that the temp. at which this takes place is about one-third of the m.p. of the metal concerned (both temp. in ° F. abs.). S. maintains that hot-pressing is superior to the conventional method of pressing and subsequent sintering of metal powders, as the temp. required is lower and the time much shorter.

—N. B. V.

1 ***The Reactivity of Solid Materials and Its Significance in Powder Metallurgy.** A. Hedvall (*Arch. Metallkunde*, 1947, 1, (7/8), 296–298).—The surface reactivity of powdered materials is not only influenced by thermal conditions but also by magnetic and electrical factors, radiation, supersonic vibration, and treatment with chemically inactive gases.—E. N.

1 ***The Solubility Rule in Powder Metallurgy.** H. Umstätter (*Arch. Metallkunde*, 1947, 1, (7/8), 299).—The relationship between the frequencies of the thermal molecular vibrations of metals and their tendency to form solid solutions is discussed. The thermal molecular frequency ν is obtained from the equation $\nu = \sqrt{\frac{2\Omega}{m}}$, where Ω is the surface tension and m is the absolute

molecular weight (which for hydrogen is 1.65×10^{-24} g.). Tables are given showing the values for many metals at various temp. in different gas atmospheres. Solid solutions are formed more easily the nearer the thermal molecular frequencies of the component metals approach one another. Thus, by the addition of small quantities of substances which alter the surface tension, the solubility properties of powdered metals, particularly those which have poor adhesive power, may be completely altered.—E. N.

“**The Design of Alloys**” as a Problem in Metal Ceramics. G. Ritzau (*Arch. Metallkunde*, 1947, 1, (7/8), 305–307).—The relationships between the dispersity of the components, the grain-size, the hardness, and the strength of alloys and sintered materials are discussed. It should be possible, from theoretical considerations, to produce many remarkable but useful sintered compounds, e.g. iron-copper/tungsten-carbide-cobalt/iron-alumina complexes.—E. N.

Compound Sintered Materials from Metals and Non-Metallic Materials, Especially Oxides. F. Skaupy (*Arch. Metallkunde*, 1947, 1, (7/8), 307–308).—Sintered compacts formed by powder-metallurgy methods can be divided into groups according as to how their properties are modified, for various reasons, by minor constituents. Examples are given, the two principal groups being (1) metallic compounds modified by additions of metallic oxides and (2) metallic oxides or non-metallic compounds (such as silicon carbide) modified by additions of metals.—E. N.

Technical Definitions in Powder Metallurgy. H. J. Bartels, W. Hotop, and R. Kieffer (*Arch. Metallkunde*, 1947, 1, (7/8), 311–315).—The nomenclature used in powder metallurgy and a glossary of technical terms are given.—E. N.

The Problem of the Testing and Evaluation of the Mechanical Properties of Sintered Materials. Wilhelm Jung-König and Günter Wassermann (*Metallforschung*, 1947, 2, (7/8), 244–249).—The mechanical properties, such as

hardness, tensile and impact strengths, of articles made by powder-metallurgy methods depend to a great extent on the porosity of the material; hot pressings have values far greater than those of sintered compacts.—E. N.

How Recent Developments in Powder Metallurgy During the Last Ten Years Have Influenced Products, and Their Effect on the Work of the Production Engineer. R. W. Deutsher (*J. Inst. Prod. Eng.*, 1947, 26, (5), 137-143).—Lord Austin prize essay.—J. C. C.

VI.—CORROSION AND RELATED PHENOMENA

***The Inhibiting Effect of Nicotinic Acid (β -Pyridine Carboxylic Acid) on the Solution of Metals [Aluminium, Zinc, and Iron in Mineral Acids].** L. Hertelen (*Arch. Metallkunde*, 1947, 1, (6), 275-278).—A study was made of the rate of solution of aluminium, zinc, and iron in mineral acids containing various amounts of nicotinic acid. Although the presence of nicotinic acid retards the solubility rate in the first few minutes, as it does not form firmly adhering adsorption films on the metal surface, the inhibiting effect soon vanishes and the rate of solution of the metal increases to that obtained when nicotinic acid is absent. The magnitude of the effect not only depends on the metal but also on the nature of the acid, the temp., and the concentration of nicotinic acid.—E. N.

***Absorption of Hydrogen by Aluminium Attacked in Caustic Soda Solution.** C. E. Ransley and H. Neufeld (*Nature*, 1947, 159, (40/47), 709-710).—A letter. The absorption of hydrogen in high-purity aluminium immersed in $N/10$ NaOH noted by Moreau and Chaudron is not confirmed by the authors, who carried out 49 days' immersion tests. They found less than 0.4 c.c. hydrogen per 100 g. metal, with no evidence of surface concentration. Gases other than hydrogen appear to be associated with the oxide film.—M. A. V.

The Corrosion of Aluminium is Shown in the Return of Eros. — (*Light Metal Age*, 1948, 6, (3/4), 6-9, 26).—An examination of the statue of Eros during cleaning and repairing operations prior to its recent re-erection showed very little damage due to atmospheric corrosion. There were surface marks on the underside, probably due to spray from the fountain, and stalactite deposits on the underside of the wings. Generally speaking, the oxide film on the exposed metal surfaces was in perfect condition, and there was no selective attack at points of contact with exposed bronze and lead.—M. A. V.

Summer 1947—Eros Returns [Corrosion of Aluminium]. G. H. Fries-Greene (*Light Metals*, 1947, 10, (117), 508-516).—Cf. preceding abstract. An account is given of the condition of the statue of Eros after fifty-four years' exposure, of repairs before re-erection, and of the method used to remove deposited dirt. An average figure for all parts of the statue shows that it has been made of aluminium of about 98% purity. The statue was cleaned entirely by hand, using warm water containing a little neutral soap. The oxide skin on the surface of the metal itself was in perfect condition, and no attack other than the formation of a smooth oxide layer, even at points of contact with bronze and lead, has occurred.—F. A. F.

***Corrosion of Filters in Sugar Refineries. III.—Investigations on Ferrous Liquors [Copper, Brass, Phosphor Bronze, Monel Metal, Stainless Steels].** Inglesent and J. Anderson Storrow (*Indust. Chemist*, 1947, 23, (275), 825-834).—I. and S. carried out experiments to test whether their previous conclusion, that corrosion in sugar filters is dependent on the variations in the electrode potential of the materials of the filter (see *Met. Abs.*, this vol., 1946, 412), was valid at temp. above those of the earlier work (18° C.). The electrode potentials of the alloys previously examined were measured against a copper reference electrode in various sugar solutions at temp. in the range

20°–80° C., the tests being carried out in a thermostatically controlled cell; the sugar solutions were circulated by convection. Where the electrode potentials were large the metal pairs generally showed the same polarity at high and low temp., but considerable differences in their response to changes in temp. were noted, these differences depending on the sugar liquor used. Variations in the surface condition of the electrodes did not seem to affect the response to temp. changes. The results of the test are thought to have been affected to some extent by the convection currents in the liquor.—R. W. R.

***Copper in Diatoms.** N. Ingram Hendey (*Nature*, 1947, 159, (4045), 646).—A letter. An analysis of diatoms taken from Chichester Harbour showed a copper content of 31–164 p.p.m. by weight, the copper content of the sea water being only 7 p.p.m. by weight. It is suggested that the accumulation of copper in diatoms may prevent the settlement of other and more sensitive fouling organisms.—M. A. V.

***The Influence of the Oxide Coating on the Rate of Corrosion, Particularly of Iron.** F. Tödt (*Arch. Metallkunde*, 1947, 1, (6), 249–251).—The presence of oxide films, which have thicknesses varying between molecular dimensions and 1 mm., has important effects on the electrochemical properties of metals, particularly the rate of corrosion. The formation and disappearance of these films on iron in the first few seconds, was followed by photo-electric methods having a sensitivity up to $\frac{1}{10,000}$ mg. of iron. While in some experiments the oxide skin is destroyed in <1 sec., in other cases the rate of destruction may take up to 1 hr. to reach a maximum. Also the rate of solution of iron in the first second or less is up to ten times greater than in the following periods, and this must affect the electrochemical activity of the oxide skin.

—E. N.

Tests, Properties of Corrosion-Preventive Lubricants for Lead-Sheathed Cables in Underground Ducts—A Discussion. Howard S. Phelps and Frank Kahn (*Corrosion*, 1948, 4, (2), 37–44).—The desiderata of a grease-type corrosion-preventive cable-pulling lubricant are enumerated, together with the results of a series of tests, developed by the Philadelphia Electric Company. Results of tests on unspecified compounds are briefly discussed, and it is concluded that it will not be easy to develop a completely satisfactory lubricant.

—M. A. V.

Salt as a Medium of Corrosion of Underground [Lead] Cables. A. G. Andrews (*Corrosion*, 1948, 4, (3), 93–98; discussion, 98–100).—Severe anodic corrosion may be caused in lead cables due to return current from grounded D.C. electric railways; and if cables are maintained at a negative potential the presence of salt in the soil leads to the formation of caustic soda within the cable ducts. Sections thus affected must be flushed before damage is done.—M. A. V.

†**The Corrosion of Metals. IX.—Magnesium and Its Alloys.** — (*Sheet Metal Ind.*, 1948, 25, (251), 541–546; (253), 963–970, 978).—Cf. *Met Abs.*, this vol., p. 463. The uses of magnesium and its alloys are summarized and the corrosion characteristics considered with suggestions for prevention. Reference is made to the effect of heat-treatment of a number of alloys on their corrosion-resistance. Consideration is also given to the effect of the alloying elements: aluminium, zinc, manganese, silver, lead, calcium, silicon, sodium, cadmium, tin, antimony, bismuth, and zirconium on corrosion, particular reference being made to copper, iron, and nickel. Corrosion in the atmosphere and corrosion in liquids are briefly discussed. The series is concluded.—R. GR.

***Corrosion-Resistance of Magnesium and AZ80 α Magnesium Alloy Castings Containing Small Proportions of Silver and Lead.** R. R. Rogers and W. Dingley (*Trans. Canad. Inst. Min. Met.*, 1947, 50, 49–56 (in *Canad. Min. Met.*

Bull., 1947, (418).—Accelerated chloride corrosion tests were carried out on AZ80x magnesium alloy castings with and without silver and lead addition. Similar tests were carried out on commercially pure magnesium. Seven alloys of varying compositions were produced by adding silver and/or lead to the AZ80x alloy and 7 alloys of varying compositions were produced by adding silver and/or lead to commercially pure magnesium. Two samples of uniform size, in the machined and degreased condition—of each of the alloys were tested by the following accelerated corrosion methods: (1) total immersion in sodium chloride solution, (2) intermittent immersion in sodium chloride solution, and (3) sodium chloride solution spray. In method (1) the samples were completely immersed in 3% sodium chloride solution maintained at 35° C. for 57 days with no agitation of the solution and a comparatively small amount of aeration. In method (2) the samples were completely immersed in the same solution maintained at the same temp. for 12 sec., then completely removed from the solution for 30 sec., this cycle continuing for 4 days. Relative humidity was approx. 45% and there was a small amount of agitation and considerable aeration as samples were never completely dry. Method (3) consisted of spraying the suspended samples with 20% sodium chloride solution at an approx. temp. of 35° C. for 35 days. Samples were always wet and exposed to considerable aeration. On completion of the tests the samples were boiled in an aqueous solution containing 15% chromic anhydride and 1% silver nitrate to remove corrosion products, followed by a cold-water rinse and oven drying. Corrosion rates in mg./dm.²/day were calculated for all 42 tests, and these data indicated that there was no advantage in adding silver or lead, or a combination of silver and lead, to commercially pure magnesium in order to improve its corrosion-resistance to aqueous chloride solutions; the iron content had a considerable effect on the corrosion rate. With the AZ80x alloy the corrosion-resistance to aqueous chloride solution may be improved by the addition of 0.1% lead, 0.05% silver + 0.05% lead, or 0.5% silver + 0.5% lead.—W. A. M. P.

***On the Corrosion of Magnesium-Manganese Casting Alloys and Semi-Products.** A. Beerwald (*Arch. Metallkunde*, 1947, 1, (6), 284-285).—A study was made of the corrosion-resistance (against 1% sodium chloride solution) of cast, forged, or rolled binary magnesium-manganese alloys in the as-cast condition or after heat-treatment at: (1) 250° C. for 24-48 hr. and furnace cooling, or (2) 550° C. for 24 hr. and quenching in water. It is shown that (1) the max. corrosion-resistance is attained at 0.9% manganese; above this value the manganese content is without influence on the corrosion properties; (2) the greatest rate of corrosion occurs with alloys containing <0.9% manganese after solution treatment at 550° C.; and (3) in contrast to pure magnesium and aluminium-containing magnesium alloys, the presence of up to 0.02% iron in the binary magnesium-manganese alloys has no influence on the corrosion properties, so long as the manganese content is <0.9%.—E. N.

***The Corrosion of Silver by Bromine.** R. Weiner (*Arch. Metallkunde*, 1947, 1, (6), 281-284).—A study was made of the corrosion of fine silver by dry and wet pure bromine and bromine containing small quantities of various impurities. The results show that in all cases an adherent film of silver bromide is always formed. The rate of attack initially follows a parabolic law, but later becomes linear; it never actually ceases or retards so much that it can be said to be almost at a standstill. The presence of water and various anions does not, surprisingly, noticeably increase the rate of attack, but the presence of bromine ions or traces of iron greatly accelerates the attack, and, in this case, rapid destruction of the metal takes place. When impurities are absent and the silver bromide film adheres firmly to the metal, the rate of penetration does not exceed more than a few hundredths of a millimetre a year. Approx. rates of penetration per year are: (1) pure, dry bromine 0.03 mm.

(1) dry bromine with traces of iron 0.06 mm., (3) dry bromine and hydrogen peroxide 0.1 mm., and (4) damp bromine with traces of iron 0.17 mm.—E. N.

***The Corrosion of Phosphated High-Purity Zinc Alloys by Fire-Extinguishing Media.** R. Beythien (*Arch. Metallkunde*, 1947, 1, (6), 286–288).—The alloys studied were: (1) zinc with aluminium 0.2 and copper 4%, and (2) zinc with aluminium 15 and magnesium 0.01%, in corroding media of solutions of various carbonates or in carbon tetrachloride. The protection afforded by chromatization of the metal surface is superior to that obtained by bonderization.—E. N.

***[Corrosion Tests on] Electro-Zinc Phosphate Coatings for Iron and Steel.** E. Halls (*Metallurgia*, 1948, 38, (233), 34–36).—Passivated electro-zinc coatings on iron and steel are produced by a combined electrodeposition and phosphatizing process, have a reduced tendency to white corrosion, and improve the adhesion of organic coatings. A series of test results is tabulated. Salt-spray tests on pressed and drawn mild steel, enamelled, with various pre-treatments, showed the benefit of electro-phosphatizing. Humidity tests on electro-phosphatized steel with stoved and cellulose finishes showed the former to be better. Other tests reported are exposure-test results on spring steel (a) lacquered, (b) electro-phosphatized, and (c) electro-phosphatized and then lacquered; and durability tests on electro-phosphatized screws, on castings, and steel pressings.—M. A. V.

Mechanism of Oxidation and Tarnishing. Ulick R. Evans (*Corrosion*, 1948, (4), 149–171).—Reprint of *Electrochem. Soc. Preprint No. 91-5*, 1947, 73–74; see *Met. Abs.*, this vol., p. 39.—M. A. V.

***Oxide Films Formed on Alloys at Moderate Temperatures: Electron-Microfraction and Electron-Microscope Studies.** (Gulbransen, Phelps, and McKenna). See p. 503.

Automotive Chemicals. II.—[Corrosion of Metals by] Brake Fluids. Alvin J. Coleman (*Tech. Eng. News*, 1946, 28, (2), 65–66).—S. describes the requirements of a fluid for use in hydraulic brake systems, and lists the fluids now on the market. Among the requirements is the ability to pass a corrosion test which specifies that the weight losses of various metals on immersion at 122–77° C. for 100 hr. must not exceed certain figures. The metals concerned are tinned iron, steel, aluminium, cast iron, brass, and copper.—P. T. G.

Corrosion Problems in Communication and Radio-Equipment Design. L. P. Morris (*Corrosion*, 1948, 4, (2), 61–71).—Moisture, electric potentials, and fungi are the most frequent causes of corrosion in communications equipment. The most useful corrective measures are protective electroplating, exclusion of moisture by dipping in wax, and the use of fungicidal waxes and varnishes.—M. A. V.

***Effect of Atmospheric Corrosion on Maintenance and Economics of Overhead-Line Hardware and Guy Strand.**—I. C. J. Couy (*Corrosion*, 1948, 4, (4), 13–140).—The atmospheric-corrosion characteristics of common structural metals are given in the form of weight-exposure time curves. These take the form $W = k_1 T$ for zinc, $W = k_2 T^c$ for iron, $W = k_3 \sqrt{T}$ for copper, and $W = k_4$ for aluminium. Lead behaves similarly to aluminium. Ferrous materials have to be coated, and galvanizing is a cheap method, although not the most efficacious. Exposure tests on galvanized overhead-line hardware in industrial, urban, and rural areas, over periods up to 14 years, are summarized; the average lives were 5–8 years for 0.8 oz./ft.² coatings, 8–12 years for 1.25 oz., and 10–14 or more years for 2.0 oz. coatings. Copper is more effective, but more expensive, and also cathodic to steel, so that rapid corrosion occurs at imperfections. Lead and aluminium are effective, but difficult to apply.—M. A. V.

The Behaviour of Metallic Materials in Relation to Very Dilute Aqueous Solutions. L. W. Haase (*Arch. Metallkunde*, 1947, 1, (6), 259–264).—H. discusses: (1) the relationship between the composition of the dil. aqueous

solution, particularly of sodium chloride, and the progress of the corrosion iron, (2) the formation and properties of protective films formed on metal surfaces during corrosion, especially the hydroxides formed on lead, zinc, iron, galvanized iron, and aluminium, (3) the corrosive action of natural waters containing alkaline carbonates, and (4) the corrosion of metals by moist air and soils.—E. N.

***Metal Loss and Catalysis.** K. Wickert (*Arch. Metallkunde*, 1947, 1, 270–275).—A study was made of the corrosion of metals in solutions of metal chlorides, sulphates, and acetates. The nature of the anion and the concentration of the electrolyte have a great influence on the rate of corrosion. In sodium chloride solutions the sodium chloride acts as an accelerator to the electron-taking reaction of the oxygen; the chemical reactions which occur are described.—E. N.

Use of Inhibitors in Corrosion Control. Norman Hackerman (*Corrosion*, 1948, 4, (2), 45–56; discussion, 56–60).—The literature on corrosion inhibitors is reviewed with special reference to the specific applications of each type of inhibitor, and the theory of inhibition. A bibliography of 59 references is appended.—M. A. V.

Corrosion Inhibitors. A. G. Sussex (*Austral. Inst. Metals (Melbourne Branch) Phys. Metallurgy Div. Symposium on Recent Advances in Phys. Metallurgy. Part 3.—Corrosion*, 1946, 15 pp.).—The general theory of corrosion inhibitors is reviewed and examples are given of the use of chromates and soluble oils in waters, of organic inhibitors in acid pickling, and of inhibitors in stress-corrosion.—A. B. W.

***Corrosion Tests in Sulphuric Acid in Petroleum-Refinery Processes.** W. Friend (*Corrosion*, 1948, 4, (3), 101–111).—A wide variety of nickel-, copper- and iron-base alloys was exhaustively tested to determine the utility of each in a refinery where sulphuric acid is the main corroding agent. Results of the tests are given in detail; Monel and Hastelloy-type alloys were suitable for many purposes; in some severely corrosive conditions, where turbulent flow of acid was encountered, high-silicon cast irons were better.—M. A. V.

Practical Corrosion Tests. S. C. Johnson (*Austral. Inst. Metals (Melbourne Branch) Phys. Metallurgy Div. Symposium on Recent Advances in Phys. Metallurgy. Part 3.—Corrosion*, 1946, 20 pp.).—J. deals with the selection of materials and planning of tests to provide information on which to base the design of plant. The use of electrochemical, laboratory-exposure, pilot, and service tests is discussed. J. points out the difficulties in interpreting results and the pitfalls of accelerated tests. Some examples are given in which corrosion tests indicated the most suitable materials for certain practical applications.—A. B. W.

Chemical Research and Corrosion Control: Some Recent Contributions from a Corrosion Research Group. W. H. J. Vernon (*J. Soc. Chem. Ind.*, 1947, 1, (5), 137–142; and *Corrosion*, 1948, 4, (4), 141–148).—M. A. V.

Corrosion and the Periodic System. K. Wickert (*Arch. Metallkunde*, 1947, 1, (6), 278–281).—When the metals are grouped in the periodic system according to their electron-giving–electron-taking properties, not only can their corrosion properties be explained but also their general physical and chemical properties. The various groups are described together with the position in the classification, of the components of the Hume-Rothery phases, the Zintl compounds, and the Laves phases.—E. N.

The Application of Electrochemical Theory to Corrosion. G. M. W. Brown (*Austral. Inst. Metals (Melbourne Branch) Phys. Metallurgy Div. Symposium on Recent Advances in Phys. Metallurgy. Part 3.—Corrosion*, 1946, 9 pp.).—The current tendencies in fundamental research on corrosion, stress-corrosion and corrosion fatigue are reviewed, referring particularly to the work of

Evans and collaborators on the significance of anodic and cathodic polarization curves.—A. B. W.

***New Aspects of the Attack on Metals Resulting from the Action of Local Cells.** K. Wickert (*Arch. Metallkunde*, 1947, 1, (6), 251–259).—The corrosion of metals, particularly iron, was studied using the following apparatus. Two flasks, each containing N/10-sodium chloride solution and an electrode of mild steel (0.05% carbon), were connected by a calcium chloride tube and a millimeter placed in the circuit. Oxygen was passed into one flask and nitrogen into the other; under these conditions the flask containing oxygen acts as a cathode and that containing nitrogen acts as an anode. The whole arrangement, which is simply an oxygen concentration cell, is referred to as an N_2-O_2 cell and the laws of the circuit are briefly outlined. Determinations were made of the loss in weight of the electrodes and the influence of mechanical and chemical processing of the electrode surfaces and of tarnish films were studied, as well as corrosion at the solution/air interface; the coeff. of anodic metal loss was calculated. The results show that the theory of electrochemical metal loss at the anode being due to differential aeration is invalid and in its place the following principles apply: (1) in the N_2-O_2 cell with active electrodes in an indifferent electrolyte the cathode suffers the greater loss of metal, while with passive electrodes the anode suffers the greater loss; (2) in the N_2-O_2 cell with active electrodes in an indifferent electrolyte the loss of metal at the cathode is greater than that at the anode by a magnitude of more than the first order (calculated from the electron flow); (3) in the case of single active electrodes in an indifferent electrolyte the loss of metal during treatment with oxygen is the same as the loss of metal at the cathode in the N_2-O_2 cell with active electrodes; a similar result is obtained using passive electrodes; and (4) in the case of single electrodes in an indifferent electrolyte, the loss of metal during treatment with nitrogen is less than that occurring at the anode in the N_2-O_2 cell.—E. N.

Polarographic Study of Corrosion Phenomena. I.—Introduction—Experimental Technique—Analysis and Interpretation of Polarograms. Pierre van Rysselberghe, John M. McGee, Armin H. Gropp, Robert D. Williams, and Paul Delahay (*Corrosion and Material Protection*, 1948, 5, (2), 11–16).—The polarograph is used to follow the variation in concentration with time of such substances as oxygen, carbon dioxide, hydrogen peroxide, hydrogen ion, &c., as indicated by their polarographic reduction currents. The emphasis in this work is on following the consumption of such substances rather than the production of metal ions. Full details are given of the experimental technique used and of the interpretation of the curves obtained.—G. T. C.

VII.—PROTECTION

(Other than by Electrodeposition)

The Insulation of Aluminium Conductors by Anodic Oxidation. Jean Odier (*Rev. Aluminium*, 1947, (136), 259–264).—A description of methods developed by two French companies for the continuous anodizing and lacquering of aluminium wire. The sulphuric process is used with A.C. superimposed on D.C. Various specially developed tests are also described for adhesion, continuity, flexibility, and other film characteristics. It is claimed that wire so treated will not break down under an applied voltage of 220 V., at a temp. of 500° C.—F. A. F.

The Painting of Aluminium Alloys. G. L. N. Watkins (*Aluminium Courier*, 1948, (3), 6).—Brief notes on the preparation of aluminium alloys for painting and the application of priming and finishing coats with special reference to the painting of small boats fabricated in these materials.—W. A. M. P.

***Recent Investigations Into the Hot-Dip Tinning of Steel Spoons and Forks.** W. E. Hoare and K. W. Caulfield (*Sheet Metal Ind.*, 1948, **25**, (253), 925-93, 932).—After a brief description of present methods for hot-tinning tableware, details are given of an investigation to determine preferred procedure for the preparation, dip-tinning, and manipulation of these articles in volume production.—R. GR.

Tin as a Coating Material in the Wire Industry. Bruce W. Gonser (*Wire and Wire Products*, 1947, **22**, (3), 207-210, 242-243).—Presented before the Wire Association. Suggested improvements in hot tinning include the use of gaseous fluxing and pickling methods, preheating in molten flux to shorten the time of immersion in the tin, and filtering methods to remove compounds from the tin bath. Methods of tinning by electrolysis, replacement from aqueous solutions or molten salts, and vapour plating are briefly reviewed.—J. C. C.

***On the Protection of Iron Parts in Contact with Sea Water by Galvanic Contact with Zinc.** F. Tödt (*Arch. Metallkunde*, 1947, **1**, (6), 288-289).—Iron cooler tubes can be satisfactorily protected against corrosion by artificial sea water when placed in galvanic contact with zinc; the ratio of zinc to iron surface may be as low as 1:1000. The effects of: (1) variations in the composition of the zinc, (2) the formation of surface films on the zinc, (3) the prevailing c.d. on the zinc, and (4) variations in the pH of the artificial sea water, are described.—E. N.

The Production of Flexible Zinc Coatings. Heinz Bablik (*Corrosion and Material Protection*, 1948, **5**, (2), 8-9).—B. points out that there are two main factors in the production of flexible zinc coatings, namely the adhesive strength of the zinc to the iron base and the deformation characteristics of the coating itself. Good bending quality of the coating may be due to either factor. If the adhesion is good, even if the coating itself has poor flexibility, bending may result in cracking but not detachment, and conversely if the zinc itself is very flexible, bending will not cause peeling, even if adhesion is relatively poor. B. describes the properties and functions of the alloy layers in the coating and mentions the two chief methods of improving adhesion, namely by heat-treatment after dipping and by addition of aluminium to the galvanizing bath.—G. T. C.

***The Electrochemical Investigation of Metals Protected by Basic Coatings.** V. Čupr (*Arch. Metallkunde*, 1947, **1**, (6), 264-267).—The corrosion-resistance values of metal coatings, particularly those of phosphate or basic films are best determined by electrochemical methods. For a true appreciation of these values it is necessary to know: (1) the potential of the metal and its dependence on the pH of the bath; (2) the c.d., on which depends the anodic and cathodic polarization effects and, therefore, solution of any oxide film present; and (3) the electrical resistance of the coating. Methods of measuring these factors are described and, from the results obtained by such determination, an attempt is made to assess the relative values of various coatings.—E. N.

Corrosion Prevention and Protection. F. R. Morral (*Wire and Wire Products*, 1947, **22**, (2), 133-138, 175).—An analysis is given of the factors to be considered in any corrosion problem, with a *bibliography* of 109 references.—J. C. C.

Selection of Protective Coatings for Metals. K. G. Compton (*Corrosion and Material Protection*, 1948, **4**, (3), 112-123).—The properties, methods of testing, and application of protective coatings (classified as noble and sacrificial metal coatings, organic and inorganic coatings) are surveyed.—M. A. V.

A New Instrument for Measuring the Flexibility and Adhesion of Surface Coatings. H. W. Chatfield (*Paint*, 1947, **17**, (9); and (summary) *Production Finishing*, 1948, **12**, (6), 88, 90, 92).—S. G.

Reduction of Wear and Corrosion by Means of Local Metallic Deposits. A. R. Lytle (*Machine Design*, 1946, **18**, (May), 131-136; and (abridged translation) *Machines et Métaux*, 1947, **31**, (341), 15-16).

Plastics for Corrosion Control. J. W. Shackleton (*Corrosion*, 1948, **4**, (4), 172–178).—The characteristics of plastics for use as protective coatings are outlined. Cellulosic plastics have been used for wrapping pipes in acid or alkaline soils, but have limited applications. Polyvinyl chloride resists organic solvents, but is soluble in water. Acrylic resin (Lucite) is useful in plating baths, and has good mechanical properties. Vinylidene chloride (Saran) has the disadvantage that slight instability produces hydrogen chloride gas, which may attack the base metal; vinyl chloride resins are more stable, but less resistant, although they are useful in electroplating operations. Polyamide resins (Nylon) are tough, abrasion-resistant, and resist most organic solvents and hot, strong alkali, but are attacked by mineral acids, and some are soluble in alcohol–water mixtures. Polythene is difficult to apply, but resists inorganic chemicals of all kinds, except that it absorbs free halogens. Its mechanical and physical properties are excellent. Tetrafluoroethylene (Teflon) has extraordinary chemical inertness, and is attacked only by molten alkali metals and by fluorine at 300° F. (149° C.). Its mechanical and electrical properties are also outstandingly good, but unfortunately it is difficult to fabricate.—M. A. V.

Magnesium Anodes for Protecting Water Heaters and Storage Tanks. — (*Modern Metals*, 1948, **4**, (2), 32–34).—Thin magnesium rods inserted into water heaters and storage tanks are proving effective in minimizing galvanic corrosion, a 2-lb. magnesium anode being expected to last about six years.

—N. B. V.

Cathodic Corrosion Protection Studied at Dow Chemical's Metals Protection Laboratory. — (*Steel*, 1947, **121**, (19), 106–107, 124).—A brief outline of the research programme on the use of magnesium for cathodic protection.

—M. A. V.

Author's Reply to Discussion of Paper, "Location and Selection of Anode Systems for Cathodic Protection". D. B. Good (*Corrosion*, 1944, **4**, (4), 188–189).—Cf. *Met. Abs.*, this vol., p. 414.—M. A. V.

VIII.—ELECTRODEPOSITION

Bright Chromium Plating and Temperature Control. M. G. Herbach and J. W. Bowden, Jr. (*Metal Progress*, 1947, **51**, (2), 257–259; and (abridged) *Products Finishing*, 1947, **11**, (10), 62, 64).—Temp. control is very important in efficient chromium plating. Curves show the relation between temp. and c.d. for obtaining satisfactory bright deposits from a bath of given composition, and a system of temp. control is described.—N. B. V.

Streamlined Analytical Control of Gold Alloy Plating Solutions. (Nell). See p. 520.

The Lead Plating of [Aluminium-] Bronze Bearing Surfaces for High-Pressure Fuel Pumps. H. Silman and M. F. E. Fry (*J. Electrodepositors' Tech. Soc.*, 1948, **23**, 43–52; discussion, 53–58).—The use of lead plating for the purpose of increasing the life of an aluminium-bronze rotor of a fuel pump for gas-turbine engines is described. Details of the design and materials of construction of the pump are given. Direct lead plating from the normal fluoroborate bath was unsatisfactory, deposits being poorly adherent and coverage of the brass patchy. Even when apparently satisfactory deposits were obtained, blistering often occurred during the final heat-treatment of the rotors. It was finally decided to apply a coat of tin before lead plating. Details of the cleaning and preparation of the metal are given. After cleaning, the parts were etched in a mixture of 30% nitric acid, 40% sulphuric acid, and 30% water. They were then given a flash coating of tin in a sodium stannate

solution containing sodium stannate 12-16, sodium acetate 5.0, and caustic soda 2.0 oz./gal. To avoid subsequent blistering a double-flash tinning was needed, the original tin flash being removed by a short immersion in the etching solution mentioned and the flash tinning repeated. Increasing the duration of the etch alone does not give the same result as double-flash tinning. The initial flash deposit should not be more than 0.00005 in. thick, a thickness corresponding with the point at which the deposit loses its opalescence and becomes uniformly white in appearance. The c.d. should not exceed 20 amp./ft.² The rotors were then plated with lead from this bath: basic lead carbonate 50, hydrofluoric acid (40%) 80, boric acid 32, and glue 0.03 oz./gal. This is used in a rubber-lined steel tank or a lead-lined or wooden one. Details are given of the operating conditions of the bath. 0.0004 in. of lead is deposited, and this is followed by a further flash tin deposit about 0.00005 in. thick. This final tin coating is infused into the lead by a heat-treatment in an oil bath at 120° C. The temp. is gradually raised to 160°-165° C. and maintained there for 2 hr. As a result of the poor throwing power of the lead bath, the lead coating may have uneven thickness and it is therefore necessary to lap the face of the rotors in order to obtain the required degree of flatness. The thickness of lead can be checked by stripping anodically in 10% ammonium acetate solution and analysing the resulting solution. Too heavy a lead deposit may lead to stripping. So may incorrect tin infusion.—G. T. C.

***Electrodeposition of Metallic Coatings on Magnesium Alloys.** R. R. Rogers and M. L. Boyd (*Sheet Metal Ind.*, 1948, **25**, (253), 959-962).—Presented at the Third International Conference on Electrodeposition. R. and B. describe experimental work on the deposition of zinc and composite-metal coatings on magnesium alloys containing small proportions of silver or lead, and preferred conditions for plating on magnesium alloys from fluoroborate baths.—R. Gr.

Recent Magnesium Developments: Electroplating Magnesium; High-Frequency Superimposed A.C. Magnesium Arc Welding; Brazing of Magnesium. W. S. Loose (*Modern Metals*, 1948, **4**, (3), 26-28).—Magnesium and its alloys in all forms can be successfully electroplated by the usual methods, once the surface has been suitably prepared by degreasing and immersion in a solution which deposits a thin layer of zinc. Details of the procedure are given. Superimposition of H.F. on A.C. greatly facilitates the arc welding of magnesium. M alloy is the only magnesium alloy which can at present be brazed, owing to the high m.p. of the filler rod.—N. B. V.

***The Relative Merits of Electrodeposited Nickel and Chromium.** R. E. Wilson (*J. Inst. Prod. Eng.*, 1947, **26**, (9), 329-348).—The effects of heating chromium and nickel deposits at 200°-800° C. for periods of up to 6 weeks are compared. Chromium deposits show a temporary increase in hardness after the initial softening, and thereafter show a steady decrease at 200°-600° C. Nickel deposits show no appreciable softening at or below 400° C.; at 600°-800° C. softening occurs for about 10 days, but thereafter the hardness remains stable. Nickel deposits are recommended to impart resistance to corrosion-fatigue and fretting, as an underlay for chromium, and for press or drive fits. Chromium is recommended as a bearing surface. The effects of pits and sharp angles on deposits are discussed and examples of some engineering applications described.—J. C. C.

The Brightening Action of Organic Sulphonates in Bright Nickel Plating. G. E. Gardam (*Sheet Metal Ind.*, 1948, **25**, (252), 743-746, 755).—Presented at the Third International Conference on Electrodeposition.—R. Gr.

***Deposition of Nickel-Cobalt Alloys from Chloride Solutions.** C. B. F. Young and Clifford Struyk (*Trans. Electrochem. Soc.*, 1946, **89**, 383-413; discussion, 413-416).

***Electroplating and Cathodic Pickling as Causes of Hydrogen Embrittlement [of Stainless Steel].** Carl A. Zapffe and M. Eleanor Haslem (*Wire and Wire Products*, 1947, 22, (5), 351–356, 379–381).—Cf. *Met. Abs.*, this vol. p. 108. A simple const.-rate single-bend test to measure embrittlement in wire specimens is described, and curves are given to illustrate the influence of temp. on the rate of embrittlement of annealed stainless-steel wire. Hydrogen is absorbed with equal readiness from 10% sulphuric acid or 10% caustic soda by cathodic pickling. The rate of embrittlement is greatly increased by the addition of a very small amount of arsenic to the solution and, to a less extent, by bubbling hydrogen sulphide through it. Chromium plating causes very much more severe embrittlement than “hydrogen plating”. Cadmium plating for short periods is also rather more damaging, although as the deposit thickens it forms an impermeable protective layer and the basis steel tends to recover ductility as though hydrogen charging had stopped.—J. C. C.

Electrodeposition of Tungsten Alloys on Metal Surfaces. — (*Steel*, 1947, 121, (26), 63, 66).—Cf. *Met. Abs.*, this vol., p. 350. A digest of Technical Report No. 1152 of the [U.S.] National Bureau of Standards. Cobalt-tungsten was the alloy most easily deposited; the bath composition is given. Max. percentages of tungsten were 35% with nickel, 50% with cobalt, and 60% with iron. The chief feature of the coatings was their extreme hardness; e.g. iron-tungsten deposits had hardnesses up to 700–950 Vickers.—M. A. V.

Electrodeposition of Tungsten Alloys. — (*Corrosion and Material Protection*, 1948, 5, (2), 10, 17).—Cf. *Met. Abs.*, this vol., p. 350. Details are given of the production of smooth, thick deposits of tungsten alloyed with cobalt, nickel, or iron. The alloy coatings produced are hard and retain their hardness at elevated temp. Anodes may be of tungsten, cobalt, or of an alloy of the two. Salts of other organic hydroxy acids may be used in place of Rochelle salt in the bath. The nickel-tungsten and nickel-cobalt alloys can be plated to a thickness of 0.02 in. without appreciable nodule formation. As formed, they are brittle, but heat-treatment makes them ductile. Vickers hardness of the material as plated is 400–700 for the nickel and cobalt alloys and 700–900 for the iron alloy. Heating at 600° C. may increase the hardness by 100 points. Resistance of the nickel and cobalt alloys to chemical attack, except by nitric acid, is not much greater than that of pure nickel or cobalt. The solutions used have good throwing power and therefore have an advantage over chromium solutions for the production of hard coatings on irregularly shaped objects.—G. T. C.

Plating of [Zinc-Base Alloy] Die-Castings. Including Buffing, Cleaning, Plating, and Stripping. C. F. Nixon (*Products Finishing*, 1947, 12, (3), 42, 44, 46, 48, 50, 52, 54, 56, 58).—Presented to the American Electroplaters' Society. See *Met. Abs.*, this vol., p. 15.—G. T. C.

Steel Pipe Electroplated Inside for Corrosion-Resistance. S. G. Bart (*Corrosion and Material Protection*, 1946, 3, (8), 8–10).—B. tells of a process, for which patents are pending, which electrolytically deposits a predetermined thickness of nickel or other corrosion-resistant metal on the inside surface of steel pipe, tubing, fittings, &c. It is claimed that smooth pore-free deposits 0.005 to 0.100 in. thick can be obtained, and although it is said that it was necessary to develop a new plating machine involving principles new to the field of electrodeposition, no details are given. It is claimed that material can be cold or hot worked, flame cut or welded (using Monel-metal or stainless steel welding rod) without damage to the electrodeposited coating. The statements all appear to refer to nickel coatings.—P. T. G.

Anodes.—II. E. R. Thews (*Metal Finishing*, 1948, 46, (4), 61–66, 75).—Cf. *Met. Abs.*, this vol., p. 193. T. describes (1) gold anodes, discussing in some detail the question of passivity of such anodes and the causes of this phenomenon. Insoluble anodes for gold plating, i.e. platinum, sheet steel,

stainless steel, and carbon, are considered briefly; (2) zinc anodes, stressing the need for an electrolytically pure zinc, but also mentioning the use of alloy anodes containing mercury and aluminium; the use of lead alloy anodes for bright zinc plating is briefly referred to; (3) cadmium anodes, emphasizing the need for high purity; (4) tin anodes, including a note on the correct filming of these anodes in alkaline plating baths; (5) lead anodes; and (6) anodes for chromium plating.—G. T. C.

A Note on the Measurement of Plating Thickness. C. H. R. Gentry (*Analyst*, 1948, **73**, (864), 157–158).—The “penetration point” in the B.N.F.M.R.A. jet test is detected by using a commercial valve voltmeter.

—F. M. L.

Features of the Slot Plating Range Cell. J. B. Mohler (*Steel*, 1947, **121**, (18), 92, 118).—Test cells for determining the plating range of a bath by plating through a slot are described.—M. A. V.

Rectifiers for Electroplating.—**VI.** Louis W. Reinken (*Metal Finishing*, 1948, **46**, (4), 67–72).—Cf. *Met. Abs.*, this vol., p. 351. R. considers various practical points in connection with rectifier installation and maintenance under the headings of input and output protection, ventilation, air filters, cold-weather problems, general maintenance procedure, circuit testing; &c.

—G. T. C.

Equipment for the Finishing Department: 149 New Products and Processes for Metal Cleaning, Rust-Proofing, Coating, and Plating. (—) See p. 542.

Stripping of Electrodeposits. Norman D. Hoffman (*Plating*, 1948, **35**, (4), 351–352, 404).—H. describes the various uses of stripping and mentions the difficulties experienced and the factors which influence the choice of stripping solution. He lists 17 different stripping solutions and indicates the purposes for which each may be used and the precautions to be observed.—G. T. C.

Treating Cyanide Waste from Metalworking Plants. — (*Steel*, 1947, **121**, (11), 93, 112, 114, 117).—Chlorine may be used for oxidizing cyanide waste from various metallurgical processes, including chromium plating, and rendering them non-toxic. Control of pH is important, and alkali is added for this purpose. Technical details are given of the plant and its operation.

—M. A. V.

Cleaning, Finishing, Plating: New Developments and New Applications—a Review in Three Parts. (Snavelly. Combs. Safranek). See p. 542.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition)

***The Anodic Behaviour of Metals. III.—Nickel.** A. Hickling and J. E. Spice (*Trans. Faraday Soc.*, 1947, **43**, (11/12), 762–769).—Cf. *Met. Abs.*, 1945, **12**, 364. H. and S. describe the initial build-up of anodic polarization at a nickel anode over a wide range of conditions, the experiments being carried out using a cathode-ray oscillograph.—P. L.

***Irreversible Electrode Potentials of Metals and Their Solid Solutions. I.—Irreversible Electrode Potentials of Metals. II.—Electrode Potentials of Solid Solutions.** G. W. Akimov and G. B. Clark (*Trans. Faraday Soc.*, 1947, **43**, (11/12), 679–684, 685–697).—A. and C. describe a method developed for the measurement of electrode potential of metals and alloys during the rubbing of the surface of a test-piece under a solution. From the comparison of the potentials so obtained, without rubbing and while rubbing, conclusions could be reached as to the tendency of the metal to form a protective film. The electrode potentials of 22 metals and 23 systems were determined, and the conclusions are stated.—P. L.

***Reversible Overvoltage.** Edgar Newbery (*Trans. Faraday Soc.*, 1947, **43**, (3), 127–138).—Experiments with an improved form of cathode-ray oscillograph are described, and show that the total opposition to the passage of current between electrode and electrolyte when a gas is liberated consists of two distinct parts, an irreversible and a reversible. The former is due to the electrical resistance of a film of gas completely covering the electrode surface, this resistance being determined by the mechanical nature of the electrode surface and the c.d. The latter is made up of four factors: (1) concentration polarization, (2) back ionization of the deposited gas, (3) back ionization of the electrode itself, (4) back ionization of overvoltage compounds of the gas with the electrode metal. Behaviour of the following individual electrodes is discussed: copper, silver, gold, zinc, cadmium, mercury, aluminium, antimony and bismuth, chromium, lead, iron, nickel and cobalt, platinum. N. concludes with a summary of the internal mechanism of cathodic liberation of hydrogen.

—P. L.

***Hydrogen Overpotential and the Thermionic Work Function.** J. O'M. Bockris (*Nature*, 1947, **159**, (4042), 539–540).—A letter. The hydrogen overpotentials and thermionic work function of a number of metals, when plotted against atomic numbers, show a periodic variation, the former rising as the latter falls, and *vice versa*. These facts are at variance with Gurney's theory, and with Adam's views. It is suggested that the work function of a metal is a measure of its electron affinity, and therefore of its tendency to acquire an electron from the hydrogen atom. Assuming that a catalytic reaction of adsorbed hydrogen forms the limiting stage in hydrogen overpotential, this provides an explanation of the graph.—M. A. V.

***The Electrochemical Investigation of Metals Protected by Basic Coatings.** (Cupr). See p. 512.

XI.—ANALYSIS

***Spot-Tests for the Detection of Alloying Elements in Aluminium- and Magnesium-Base Alloys.** B. S. Evans and D. G. Higgs (*Analyst*, 1946, **71**, (847), 464–474).—Spot-tests are described for the detection of Cu, Mg, Zn, Mn, Sn, Fe, Ni, Ti, Sb, Bi, Pb, and Cr in Al-base alloys and of Al, Mn, Zn, Cu, Sb, and Cd in Mg-base alloys. The tests are based on conventional reactions such as the oxidation of Mn to HMnO_4 with sodium bismuthate, the reaction of Ni with dimethylglyoxime, and Fe with NH_4CNS , or on coloured complexes or solutions formed with organic reagents, e.g. the green precipitate given by Cu with α -benzoinmonoxime, the red colour given by Zn with diphenylcarbazone, and the blue precipitate given by Mg with quinalizarin.

—F. M. L.

***The Direct Photometric Determination of Aluminium with 8-Hydroxyquinoline.** C. H. R. Gentry and L. G. Sherrington (*Analyst*, 1946, **71**, (846), 432–438).—Aluminium hydroxyquinolate is extracted with chloroform from an aqueous solution at pH 5 or 9 and the colour of the extract measured absorptiometrically. Interference of Cu, Co, Ni, Zn, and Cd is eliminated by extracting at the higher pH in the presence of KCN and of Fe by warming with KCN and Na_2S to form $\text{K}_4\text{Fe}(\text{CN})_6$. As an example of the use of the method, details are given for the determination of traces of Al in WO_3 .—F. M. L.

***Fluorimetric Determination of Aluminium in Steels, Bronzes, and Minerals.** Alfred Weissler and Charles E. White (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (9), 530–534).—After elimination of interfering elements by electrolysis with an Hg cathode, Al is determined fluorimetrically using the dyestuff Pontachrome Blue-Black R at pH 4.8 in buffered solution. A sensitivity of 1 part in 10^8 is claimed.—F. M. L.

***The Precipitation of Aluminium and Its Separation from Cobalt, Chromium, Nickel, or Zinc by Means of Ammonium Benzoate.** A. A. Smales (*Analyst*, 1947, **72**, (850), 14-16).—To the slightly acid (HCl) solution containing Al in a vol. of 250-300 c.c. are added 1 g. of NH_4Cl , 20 c.c. of 10% ammonium acetate solution, 20 c.c. of 10% ammonium benzoate solution, and 2 c.c. of bromophenol-blue indicator solution. The solution is heated to 80°C ., sufficient HCl added to dissolve any precipitated aluminium benzoate, then dil. ammonia run in slowly until the indicator just begins to change colour and precipitation just begins. The solution is boiled for a short time then more ammonia run in until the indicator gives the red-blue colour characteristic of pH 3.5-4. The solution is boiled gently for 2-3 min., set aside on the water bath for 30 min., and the precipitate filtered off, washed with hot water containing 10 g. of ammonium benzoate and 20 c.c. of glacial acetic acid per l., and ignited to Al_2O_3 . A single precipitation thus carried out gives a separation of 50 mg. of Al from up to 100 mg. of Co^{II} and Cr^{VI} , but a double precipitation is desirable for similar amounts of Ni^{II} and Zn.—F. M. L.

***A System of Qualitative Analysis for the Common Metals in Presence of Phosphates Using Ammonium Benzoate.** G. J. Austin (*Analyst*, 1947, **72**, (859), 443-446).—For a group separation in presence of PO_4^{3-} , ammonium benzoate is used to precipitate Fe, Al, and Cr after Sr and Ba have been separated as sulphates. Zn, Co, Ni, Mn, Ca, and Mg remain in the filtrate and can be detected by usual procedures.—F. M. L.

The Polarographic Estimation of Antimony in Cable-Sheathing Alloy B (B.S. 801). H. F. Hourigan (*Analyst*, 1946, **71**, (848), 524-527).—By carefully adjusting the PbCl_2 content of the electrolyte, Sb can be determined polarographically with good accuracy.—F. M. L.

***The Analysis of Barium Carbide.** A. H. Edwards (*Analyst*, 1946, **71**, (848), 521-524).— BaC_2 is evaluated by the pressure of gas set up in a closed system when the BaC_2 is treated with H_2O . Analysis of the gas for objectionable impurities such as H_2S and PH_3 can be carried out. Specific methods are given for determination of oxide, free and total C, carbonate, and cyanide.

—F. M. L.

***Photometric Micro-Determination of Calcium.** H. A. Deluca (*Canad. J. Research*, 1947, [B], **25**, (5), 449-454).—A method for the determination of Ca in amounts ranging from 0.04 to 0.16 mg. Ca is precipitated from the solution (5 ml.) as oxalate, by the addition of 0.2 ml. saturated ammonium oxalate solution, adjustment of the pH to 3.5 with 2N-HCl and N-NaOH, followed by standing for 2 hr. and centrifuging for 15 min. at 3000 r.p.m. The precipitate is then suspended in 0.3 ml. of 5% ammonium oxalate solution and again centrifuged. The centrifuge tube is placed in a muffle and the temp. is slowly raised to 475° - 500°C . and held there for 1 hr. The carbonate thus obtained is dissolved in exactly 1 ml. of 0.01N-HCl and heated on a water bath to expel the CO_2 . After cooling, 0.2 ml. of 0.5% KIO_3 solution and 0.2 ml. of 10% KI solution are added. The solution is allowed to stand for 15 min. to allow the excess acid completely to liberate the iodine; 10 ml. of 10% KI is then added. The solution is transferred to a 25 ml. volumetric flask and its absorption is compared, using an Evelyn colorimeter, with that of a blank. The Ca present is determined from a calibration curve.—R. W. R.

***Analysis of Cemented-Carbide Compositions.** W. O. Touhey and John C. Redmond (*Analyt. Chem.*, 1948, **20**, (3), 202-206).—The sample is crushed to -200 mesh using a mortar with a carbide insert and a carbide-tipped pestle driven by a small riveting hammer. Total C is determined by combustion and free C by dissolution of the sample in HNO_3 and HF followed by filtering off and washing the C which is finally determined by combustion. For determination of metallic constituents the sample is dissolved in HNO_3 and HF and the solution fumed with HClO_4 ; after cooling it is diluted, HCl

added, and W precipitated with cinchonine. The precipitate, which contains Mo, Ta, Nb, and Ti, if present, is ignited and weighed. The mixed oxides are fused with KHSO_4 , the melt leached out with tartaric acid solution, and cupferron added to precipitate Ta, Nb, and Ti; the precipitate is ignited and weighed. W (including any Mo) is estimated by difference; Mo can be determined colorimetrically with KCNS after separation as sulphide. Fe, with any residual Ta, Nb, and Ti, is recovered from the filtrate from the cinchonine precipitate with cupferron and the ignited precipitate added to the oxides recovered previously. The combined oxides are fused with KHSO_4 and the melt leached with tartaric acid. Fe is precipitated with H_2S and determined by titration, Ti is determined in the filtrate colorimetrically with H_2O_2 , Nb by reduction in a Jones reductor and titration, and Ta by difference. Co, Ni, and Al are separated and determined in the filtrate from the cupferron precipitate of Fe, &c., by normal methods. Spectrographic analysis is used as a guide to the determinations required.—F. M. L.

***Determination of Chromium by Oxidation with Perchloric Acid.** Sigmund Schuldiner and Frederick B. Clardy (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (11), 728–729).—Any Cr volatilized as CrO_2Cl_2 during fuming with HClO_4 is condensed in an air condenser and collected in water. An apparatus suitable for the fuming operation is described.—F. M. L.

***The Separation of Cobalt from Nickel and the Colorimetric Determination of Nickel.** A. J. Hall and R. S. Young (*Analyst*, 1946, **71**, (847), 479–482).—Prior to determining Ni colorimetrically in a Spekker absorptiometer by extracting the dimethylglyoxime complex with chloroform, Co (up to 0.2 g.) is removed by extraction of the thiocyanate complex with a mixture of amyl alcohol 3 parts and ether 1 part.—F. M. L.

***Colorimetric Determination of Cobalt in Metallurgical Products with Nitroso R Salt.** R. S. Young, E. T. Pinkney, and R. Dick (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (8), 474–476).—The sample is dissolved in a mixture of HNO_3 , HCl , and Br_2 and the solution then taken to fumes with H_2SO_4 ; the solution is cooled, diluted, 2 c.c. of HCl added, and H_2S passed. Any sulphide precipitate is filtered off and the filtrate boiled to expel H_2S , oxidized with HNO_3 , and again fumed. The solution is cooled, diluted, made just alkaline with NaOH , then acidified with a mixture of H_3PO_4 and H_2SO_4 ; nitroso R salt solution and sodium acetate are added, the solution boiled with HNO_3 , cooled, and made up to volume. The developed colour is measured absorptiometrically.—F. M. L.

***The Stability of the Cobaltous Thiocyanate Complex in Ethyl Alcohol–Water Mixtures and the Photometric Determination of Cobalt.** Norbert Uri (*Analyst*, 1947, **72**, (860), 478–481).—The stability of the cobalt thiocyanate complex has been worked out and it has been shown that if sufficient NH_4CNS is added dissociation of the complex can be neglected and the colour intensity is the same when working with acetone or ethyl alcohol.—F. M. L.

***Inorganic Spot-Test for Copper.** Frieda Goldschmidt and Binyamin R. Dishon (*Analyt. Chem.*, 1948, **20**, (4), 373–374).—The violet colour which appears when concentrated HBr reacts with Cu^{II} salts is used as a basis for a spot-test for Cu.—F. M. L.

Determination of Gold with Ascorbic Acid. E. C. Stathis and H. C. Gatos (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (12), 801).—Au is precipitated quantitatively in HCl solution by ascorbic acid and can be filtered off, ignited, and weighed. Alternatively, an excess of ascorbic acid may be added to the cold Au solution and the excess titrated with standard I_2 solution.—F. M. L.

***Colorimetric Determination of Traces of Gold.** E. B. Sandell (*Analyt. Chem.*, 1948, **20**, (3), 253–256).—Traces of Au are precipitated with SnCl_2 using Te as collector. The precipitate is dissolved in *aqua regia* and Au

determined either colorimetrically or photometrically with *p*-diethylamino-benzylidenetherhodanine. Taking a 1 g. trial, 0.1 p.p.m. can be detected.

—F. M. L.

Streamlined Analytical Control of Gold Alloy Plating Solutions. Karl Nell (*Plating*, 1948, **35**, (4), 345–350).—The importance of careful and regular analysis of alloy Au plating solutions is pointed out and the need for rapid analytical methods emphasized. N. describes a method of determining colorimetrically on a single 5 or 10 c.c. sample of plating solution, Au, Ag, Cu, and phosphate. Cu is determined by using the colour of the Cu-ammonia complex, Ni by the bromine-dimethylglyoxime method, Au by the use of *o*-toluidine to give a yellow colour, and phosphate by 1-amino-2-naphthol-4-sulphonic acid. Full details are given of the methods used and of the preparation of graphs for the colorimetric analysis. Separate methods are given for the determination of free NaCN and Na_2CO_3 . No figures are given to illustrate the degree of accuracy obtained with the methods described.—G. T. C.

***Differential Reduction of Iron and Tin [in Copper Alloys].** A. C. Simon, Patricia S. Miller, J. C. Edwards, and F. B. Clardy (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (8), 496–497).—Samples of Cu alloys, e.g. bronzes containing <1% of Sb, are attacked with HNO_3 , boiled, $\text{Al}(\text{NO}_3)_3$ added, and the solution neutralized with ammonia to co-precipitate Al, Fe, and Sn. The precipitate is filtered off and the paper and precipitate digested with HClO_4 and HNO_3 ; the precipitation is repeated and the paper and precipitate wet-ashed. The solution is taken to fumes of H_2SO_4 , cooled, diluted, and HCl added. Fe is reduced in the cold with Ni in an atmosphere of CO_2 and titrated with standard $\text{K}_2\text{Cr}_2\text{O}_7$ using sodium diphenylamine as indicator. Sn is then reduced by boiling the solution with Ni, again in an atmosphere of CO_2 , and titrated with standard I_2 .—F. M. L.

***Potentiometric Determination of Lead.** Ladislaus Farkas and Norbert Uri (*Analyt. Chem.*, 1948, **20**, (3), 236–237).—Pb is titrated potentiometrically with alkali fluoride after addition of an excess of NaCl or NaBr to the solution. The point at which the Pb is completely converted to PbClF or PbBrF is indicated by the drop in the $\text{Fe}^{+++}\text{--Fe}^{++}$ oxidation-reduction potential.

—F. M. L.

***The Determination of Lead in Copper, Nickel, and Cobalt by Dithizone.** R. S. Young and A. Leibowitz (*Analyst*, 1946, **71**, (847), 477–479).—To a HNO_3 solution of Cu, Ni, or Co containing 0.02–0.05 mg. of Pb is added a solution of $\text{Fe}(\text{NO}_3)_3$ in an amount such that there is 30–50 times as much Fe as there is Pb, As, Sb, Bi, Se, and Te, and the Fe is precipitated with excess aqueous NH_3 to collect these elements. The precipitate is filtered off, dissolved in HNO_3 and reprecipitated, then dissolved in HCl, and FeCl_3 extracted with ether. The solution is adjusted to pH 8, 4–5 c.c. of 50% KCN solution added, and Pb and Bi extracted with dithizone in CCl_4 . Pb and Bi are then transferred to a dil. HNO_3 phase by shaking with 10 c.c. of 5% HNO_3 , the solution adjusted to pH 2–3, and Bi extracted, if desired quantitatively with dithizone. The Pb solution is finally adjusted to pH 8 and titrated with standard dithizone.—F. M. L.

***Spot-Tests for the Detection of Alloying Elements in Lead-Base Alloys.** B. S. Evans and D. G. Higgs (*Analyst*, 1947, **72**, (852), 105–109).—Spot-tests are described for the detection of Sn, Sb, Cd, Ag, As, and Bi. It was found impossible to detect Te in the amounts present in Pb alloys.—F. M. L.

***The Determination of Mercury by Means of Dithizone.** H. Barnes (*Analyst*, 1947, **72**, (860), 469–472).—The extraction of Hg by dithizone and separation of Cu by a method based on the relative rates of extraction are discussed.

—F. M. L.

***1:2-Cyclohexanedione-Dioxime ("Nioxime") as a Reagent for Nickel.** W. C. Johnson and M. Simmons (*Analyst*, 1946, **71**, (849), 554–556).—The

reagent has been investigated as a qualitative, gravimetric, and colorimetric reagent for Ni and has been found to offer advantages over dimethylglyoxime except for gravimetric work. In the colorimetric determination using a Spekker absorptiometer the colour given by the Nioxime is stabilized with gum arabic.—F. M. L.

***The Rapid Determination of Small Quantities of Nickel with Dithizone.** R. S. Young, E. H. Strickland, and A. Leibowitz (*Analyst*, 1946, **71**, (847), 474–476).—0.01–0.1 mg. of Ni can be determined, e.g. in Zn solutions in electrolytic Zn refineries, by extracting the dimethylglyoxime complex into chloroform and then re-extracting it into dil. HCl. Dimethylglyoxime is shaken out with ether, a saturated sodium acetate– NH_4CNS solution added, and the pH adjusted to 8 with aqueous NH_3 . This solution is titrated with a standard solution of dithizone in CCl_4 .—F. M. L.

***The Determination of Nickel [in Alloys] by Precipitation with Dimethylglyoxime.** J. T. Minster (*Analyst*, 1946, **71**, (846), 424–428).—By carefully standardizing conditions it has been made possible to determine with accuracy the Ni content of alloys containing up to 99% of Ni. 0.09–0.11 g. is dissolved in 20 c.c. of 1:1 HNO_3 in a 1 l. beaker and 250 c.c. of H_2O and 25 c.c. of 10% tartaric acid solution are added. The solution is boiled, then diluted with 100 c.c. of H_2O , and 50 c.c. of a 1% solution of dimethylglyoxime added. While stirring continuously, aqueous NH_3 (density 0.88) is run in from a burette until a pink colour persists throughout the liquid; a further 5 c.c. of aqueous NH_3 is then added and the beaker set aside overnight in a place where the temp. will fall to 25°–30° C. by next morning. The precipitate is filtered on a sintered-glass crucible, dried at 105°–110° C. for 1 hr., and weighed.

—F. M. L.

***Identification of Nickel or Monel Wire in a Woven-Wire Screen.** Robert L. Hackney (*Metal Progress*, 1947, **51**, (1), 87).—The cleaned wire is dipped for 2 sec. in 50% HNO_3 , dried, dipped in 1% $\text{K}_4\text{Fe}(\text{CN})_6$, and allowed to dry in the air. Monel wires will then be found to be covered with deep pink-coloured $\text{Cu}_2\text{Fe}(\text{CN})_6 \cdot 7\text{H}_2\text{O}$ and Ni wire with slightly green-tinted $\text{Ni}_2\text{Fe}(\text{CN})_6 \cdot x\text{H}_2\text{O}$.

—N. B. V.

***The Analysis of Nickel–Cobalt–Iron Alloys Used in Glass-to-Metal Seals.** R. C. Chirnside, H. J. Cluley, and P. M. C. Proffitt (*Analyst*, 1947, **72**, (857), 351–359).—Methods are given for the accurate determination of Ni, Co, Fe, and Mn in the alloys. The direct precipitation of Ni with dimethylglyoxime was proved to be impracticable owing to the formation (which is fully discussed) of an insoluble Fe–Co–dimethylglyoxime complex. This interference is prevented by reduction of Fe to Fe^{II} with Na_2SO_3 . Accurate results are then obtained if the solution is neutralized with sodium acetate instead of ammonia, precipitation is carried out at 70° C., and the settling time is reduced to 15 min. Co is electrometrically titrated in ammoniacal solution with $\text{K}_4\text{Fe}(\text{CN})_6$ after removal of Mn as MnO_2 and addition of ammonium citrate to keep Fe in solution. After a single precipitation as basic acetate, Fe is reduced and titrated with $\text{K}_2\text{Cr}_2\text{O}_7$ using barium diphenylamine sulphonate as indicator. Mn is estimated absorptiometrically after oxidation to HMnO_4 .

—F. M. L.

***The Determination of Silicon in Nickel Alloys.** J. T. Minster (*Analyst*, 1946, **71**, (846), 428–432).—Alloys containing Ni 99 and Si 0.01–0.1% are dissolved in HNO_3 , H_2SO_4 added, and the solution electrolysed using an Hg cathode. When the green colour due to Ni has been discharged, sulphamic acid is added and the electrolysis continued for 15 min. to eliminate HNO_2 . Si in the resultant solution is determined colorimetrically by means of the silicomolybdate–Mo blue reaction. The presence of P is indicated by the paling of the yellow molybdate colour that occurs on increasing the acidity, which also prevents interference of the P.—F. M. L.

Improved Gravimetric Determination of Silicon in Aluminium Alloys, Developed in Germany During the War. W. Stross (*Metallurgia*, 1948, **38**, (223), 63-65).—The method described is based on the mutual flocculation of gelatine and silicic acid and other colloids. After acidifying, H_2O_2 is added to dissolve any remaining metallics, the solution in *slightly* boiled down, and gelatine added. A very pure silicic acid is flocculated, and is easily filtered. No recovery of silica from the filtrate or treatment with HF is necessary. Alloys containing 0.1-40% Si can be analysed in this way. The time required is 2 hr.—M. A. V.

Routine Analysis of Sodium-Potassium Alloys. S. L. Walters and R. R. Miller (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1946, **18**, (8), 468-469).—Alloys containing more than 92% of K which are solid at room temp. are analysed by freezing-point determination. Liquid alloys are sampled in a special apparatus, which ensures freedom from moisture and oxygen, and the weighed sample reacted with absolute alcohol under neohexane and the resultant solution titrated with standard acid.—F. M. L.

***Analysis of Thorium-Chromium Mixtures.** Richard E. Ewing and Charles V. Banks (*Analyt. Chem.*, 1948, **20**, (3), 233-235).—Cr is determined in Th-Cr alloys by dissolution of the sample in HNO_3 with the addition of a few drops of H_2SiF_6 followed by oxidation of the Cr with HClO_4 , taking precautions to recover any volatilized CrO_2Cl_2 , addition of excess FeSO_4 and back titration of the excess with $\text{Ce}(\text{SO}_4)_2$ using ferroin as indicator. Th is determined on a separate trial by precipitation as oxalate and ignition of the oxalate to oxide after Cr has been volatilized as CrO_2Cl_2 by bubbling HCl gas into a boiling HNO_3 - HClO_4 solution.—F. M. L.

***Spot-Tests for the Detection of Alloying Elements in Tin-Base Alloys.** B. S. Evans and D. G. Higgs (*Analyst*, 1947, **72**, (859), 439-443).—Spot-tests are described for the detection of Pb, Cu, As, Sb, Zn, and Al.—F. M. L.

A Note on the Tin Assay of British Chemical Standards. A. G. Dunbar-Poole (*Analyst*, 1946, **71**, (848), 538-539).—The author agrees with Schoeller and Holness (*Analyst*, 1946, **71**, (842), 217-220; *Met. Abs.*, 1946, **13**, 356) that the Sn content of the Bureau of Analysed Samples Standard Alloy Bronze A is 9.7-9.75% and not 9.96% as stated.—F. M. L.

***The Polarographic Determination of Tin in High-Purity Zinc and Zinc Die-Casting Alloys.** R. C. Hawkings, D. Simpson, and H. G. Thode (*Canad. J. Research*, 1947, [B], **25**, (3), 322-330).—The method enables Sn to be determined in Zn and its alloys when present in amounts between 0.001-0.2%. About 10 g. of the Zn is dissolved in 65 ml. of 30% H_2SO_4 , and the solution is diluted to 100 ml. The solution is then boiled after addition of 5 ml. of 30% H_2O_2 to oxidize the Sn, and again made up to 100 ml. An addition of 5 ml. conc. HCl is made, the solution is cooled, and 3 ml. of 5% cupferron (stabilized with phenacetin) added drop by drop with stirring. After coagulation of the precipitate, 0.1 g. of Analytical Filter-Aid is added and the precipitate is filtered on Jena No. 3 sintered glass crucible. The precipitate is washed with 20 ml. of 0.05% cupferron solution and dissolved in 10 ml. conc. HNO_3 . The solution is then fumed after addition of 4 ml. conc. H_2SO_4 ; a further addition of 5 ml. conc. HNO_3 is made and the solution again fumed. The precipitate is redissolved in 10 ml. water and transferred to a reduction flask. After addition of 4 ml. conc. HCl and 0.1 g. Al foil, the solution is heated for 15-30 min. in a stream of CO_2 . When cool 1.25 ml. 0.1% gelatin solution is added and the solution diluted to 50 ml. It is then transferred to an electrolysis cell through which a stream of N_2 is passing, and electrolysed from -0.3 to -0.7 V. using a saturated calomel reference electrode. The Sn determination is made with a Heyrovsky Model XI Polarograph; the electrolysis cell has an external anode. The method is accurate to $1 \times 10^{-4}\%$ or $2 \times 10^{-4}\%$ in the case of Zn alloys.—R. W. R.

***Colorimetric Determination of Uranium with Thiocyanate.** J. E. Currah and F. E. Beamish (*Analyt. Chem.*, 1947, 19, (8), 609–612).—U is estimated colorimetrically in the presence of large amounts of Th, Cu, and Fe (reduced with SnCl_2) by the intense yellow colour formed by UO_2^{++} with NH_4CNS .

—F. M. L.

***The Zinc Urate Oxidation Reaction : A Selective Test for Zinc.** W. R. Fearon (*Analyst*, 1947, 72, (861), 541–542).—When uric acid is suspended in a solution which is then made alkaline with NaOH and oxidized with I_2 or NaOCl , the presence of 1 part of Zn in 10^4 is indicated by a pure blue colour.

—F. M. L.

***A Method for the Determination of Zinc in Copper Alloys and for the Separation of Zinc from Cadmium.** B. S. Evans (*Analyst*, 1946, 71, (847), 460–464).—1 g. of alloy is dissolved in HNO_3 , the solution evaporated to 2–3 c.c., and then diluted to 50 c.c. with cold H_2O . Pb is precipitated by addition of Na_2SO_4 and the solution filtered and made up to volume. An aliquot (equivalent to 0.002–0.035 g. of Zn) is neutralized with Na_2CO_3 , a slight excess of KCN added, and then Mn precipitated as MnO_2 by boiling with NaOH and H_2O_2 . The solution is filtered and then boiled with 10 c.c. of 10% Na_2S solution, which precipitates ZnS and CdS ; the precipitate is filtered and washed, first with a solution of KCN, Na_2S , and KNO_3 , then 5% KNO_3 , and finally 5% NH_4NO_3 . If Cd is present, the precipitate is dissolved in 1:1 *aqua regia* and to the solution are added 20 c.c. of 20% NH_4NO_3 , aqueous NH_3 to make strongly ammoniacal, 30 c.c. of 10% KCN, and 10 c.c. of 10% Na_2S . The solution is heated just to vigorous boiling, rapidly cooled, and the precipitated CdS filtered off; ZnS is recovered from the filtrate by the addition of acetone which decomposes the cyanide complex. The ZnS is dissolved in *aqua regia* and titrated with standard $\text{K}_4\text{Fe}(\text{CN})_6$ after extraction as the diphenylcarbazone complex.—F. M. L.

***The Accurate Volumetric Determination of Zinc and Nickel Using Diphenylcarbazone as Indicator.** B. S. Evans (*Analyst*, 1946, 71, (847), 455–459).—In the determination of Zn, to a neutral solution are added 20 c.c. of 20% NH_4NO_3 solution, 15 c.c. of $\text{N}/5\text{-Na}_2\text{CO}_3$ solution, 4 drops of 10% KCN solution, H_2O to make up to 150 c.c., and 10 c.c. of acetone; after shaking and then allowing to stand for 15 min. 20 c.c. of 1:1 amyl alcohol–carbon tetrachloride mixture and 0.3 c.c. of a 1.5% solution of diphenylcarbazone in alcohol are added and the mixture shaken. The red colour in the solvent layer is titrated away with standard $\text{K}_4\text{Fe}(\text{CN})_6$. The procedure for the determination of Ni is similar except that no addition of KCN or acetone is made, the extractant is amyl alcohol alone, and the titration is carried out with standard KCN. The method can be adapted for the determination of Zn in Ni-plating baths since the Zn K cyanide complex is decomposed by acetone and a colour is given with diphenylcarbazone, whereas the Ni complex is not and gives no colour. Thus, to a plating bath is added KCN until the $\text{Ni}(\text{CN})_2$ just re-dissolves; acetone is then added followed by extractant and indicator and the Zn titrated with $\text{K}_4\text{Fe}(\text{CN})_6$.—F. M. L.

***A Method for the Determination of Minute Amounts of Zinc in Alloys Used for Making Lead Pipes and Cable Sheathing.** B. S. Evans (*Analyst*, 1948, 73, (864), 149–152).—Zn and Cd are separated from the bulk of the Pb and Sn and Sb in the normal manner and the solution so obtained neutralized with aqueous NH_3 . KCN and Na_2S are added, the solution brought just to boiling, and the precipitated CdS and PbS filtered off. The Zn in the filtrate is precipitated as sulphide by decomposing the cyanide complex with acetone. The sulphide is dissolved in *aqua regia* and Zn titrated with standard $\text{K}_4\text{Fe}(\text{CN})_6$ after extraction into amyl alcohol and CCl_4 with diphenylcarbazone.—F. M. L.

***Spot-Tests for the Detection of Alloying Elements in Zinc-Base Alloys.** B. S. Evans and D. G. Higgs (*Analyst*, 1947, **72**, (852), 101-105).—Spot-tests are described for the detection of Cu, Al, Sb, Sn, Cd, and Pb.—F. M. L.

An Indicator Changing at pH 0.5 for the Control of Sulphide Precipitation. H. G. Andrew (*Analyst*, 1947, **72**, (860), 481-482).—An indicator which is golden-yellow at pH 0.5, green at pH 1, and orange-red at pH 0 is made by dissolving 0.3 g. of hæmatoxylin and 0.06 g. of methyl violet 6B in 100 c.c. of 20% isopropyl alcohol.—F. M. L.

Experience with Photometric Procedures for the Determination of Metals. H. Cox (*Metallurgia*, 1948, **37**, (221), 270-274).—The literature on the use of photometric or absorptiometric methods for determining metals is reviewed, and methods developed for determining Cr in steel and Cr, Mo, and Fe in welding flux, are described.—M. A. V.

The Application of Rapid Analytical Methods in Industrial Laboratories. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 97-101).—M. reviews the application of: (1) spectrography for qualitative, quantitative, and semi-quantitative analysis, (2) spectrophotometry, (3) polarography, (4) colorimetry using visual and electrical methods, and (5) potentiometric analysis.—E. N.

Principles and Position of the Development of Spectrochemical Apparatus and Methods. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 102-108).—M. reviews the fundamental principles, latest types of apparatus, and modern techniques of spectrochemical analysis.—E. N.

Spectrochemical Analysis of Solid Electrodes, Particularly of Non-Ferrous Metals. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 109-114).—M. reviews the equipment necessary and the technique for qualitative and quantitative spectrochemical analysis using solid electrodes. Preparation of the electrodes is simple; if they have to be cast, then Cu, brass, or Fe moulds are most suitable. The analysis of Zn and Zn alloys is described in detail.—E. N.

Spectrographic Semi-Quantitative Analysis [of Brass and Aluminium Alloys]. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 122-123).—The technique of semi-quantitative analysis and its application to the analysis of Pb-containing brass and Al secondary alloys are described. For impurities such as Fe, Pb, and Ni in brass, the actual amounts of the elements are not determined; the intensities of their lines are compared with neighbouring Cu lines having intensities corresponding to those of the impurity limits. The following line comparisons are generally made: Fe 2382 with Cu 2357, Pb 2833 with Cu 2858, and Ni 3134 with Cu 3126 Å. The lines used for comparison in the determination of Pb, Sn, Ni, Co, Sb, and Cd in Al alloys are given. The accuracy of the method can be increased by the use of control electrodes. 240 determinations on 40 Al specimens can be performed in 2½ hr.—E. N.

The Problem of the Production of Standard Specimens for the Spectrographic Analysis of Aluminium Alloys. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 124-125).—M. describes the production of control electrodes and the composition of those produced by the German State Testing Department in Berlin.—E. N.

Sampling and Electrode Production for the Rapid and Reliable Determination of Compositions of Batches of Secondary Aluminium Alloys Cast as Small Ingots from Large Melting Furnaces. H. Moritz (*Arch. Metallkunde*, 1947, **1**, (3), 125-137).—The comparison between analyses of the melt and of the ingots produced, the distribution of the constituents in the ingot, and the sampling and analytical methods applicable to secondary Al-Cu-Mg and Al-Mg-Si alloys are discussed. As many of the constituents, such as Cu, Mg, and Pb (if present), show segregation, sampling by chipping the middles of the ingots gives inaccurate results; it is best to take cuts from the top, middle, and bottom of the ingots. The most satisfactory method of sampling the melt is to cast spectrographic electrodes at regular intervals during pouring.

Except for Cu, which must be determined colorimetrically when over 1%, spectrographic methods of analysis are suitable as the results are in good agreement with those obtained by chemical methods.—E. N.

***Spectrochemical Determination of Calcium in Magnesium Alloys.** — Müller-Uri (*Arch. Metallkunde*, 1947, 1, 3, 137-138).—The spectrochemical analysis, using glass or quartz spectrographs, of Mg alloys containing 0.03-1.2% Ca is described. Using the Ca lines 3933.7 and 3968.5 Å and the Mg line 3895.7 Å, the error is ± 3.2 and $\pm 1.8\%$ for cast and sheet electrodes, respectively. Mn can be determined also, using the Mn line 2949.2 Å, when the error is ± 2.3 and $\pm 1.8\%$ for cast and sheet electrodes, respectively.

—E. N.

Quantitative Spectrographic Analysis of Thin-Walled Light-Metal Specimens. — Müller-Uri (*Arch. Metallkunde*, 1947, 1, 3, 138-139).—A standard form of electrode is necessary if reproducible results are to be obtained in spectrographic analysis. Their production is described from: (1) sheets >0.8 mm. thick by stamping, and (2) from sheets 0.8-0.2 mm. thick, by rolling to 0.2 mm. and forming cups by drawing. In both cases these electrodes are attached to supporting electrodes.—E. N.

Instantaneous Spectrography. J. Orsag (*Bull. Groupement Avancement Méthodes Anal. Spectrograph. Produits Métallurg.*, 1947, 57-59).—Some ways of speeding up spectrographic analysis are described.—M. E.

Interpretation of Spectroscopic Phenomena by Means of the Quantum Theory. Bernard Vallentin (*Bull. Groupement Avancement Méthodes Anal. Spectrograph. Produits Métallurg.*, 1947, 65-69).—A general theoretical review.—M. E.

XII.—LABORATORY APPARATUS, INSTRUMENTS, &c.

(See also "Testing" and "Temperature Measurement and Control".)

100-kV. Electron Microscope. — (*Engineer*, 1948, 185, (4814), 421).—A general description of the Metropolitan-Vickers E.M.3 microscope.—R. Gr.

A Simple Inexpensive Ultra-Violet Analytic Lamp. G. Robinson (*Metalurgia*, 1948, 38, (223), 67-68).—The G.E.C. "Osira" high-pressure mercury-vapour lamp is described, used with a Wood's ultra-violet filter. It was designed originally for examining chromatograms, but serves as a useful general-purpose analytic lamp.—M. A. V.

Illuminator for Melting-Point Blocks. Thomas J. Haley (*Science*, 1947, 105, (2736), 604).—A letter. To ensure accurate results with copper melting-point blocks, an illuminator was constructed to replace quartz rods, which are easily breakable. A description of the device is given.—A. I. V.

The Physical Society's Exhibition. — (*Engineering*, 1948, 165, (4289), 354-356; (4290), 366-367).—An instrument is described for the preparation of reflecting and non-reflecting films by evaporation and the deposition of films of a wide variety of metals. A temp.-control instrument is also described, having an auxiliary thermocouple suppressor to minimize "hunting" of the temp.—R. Gr.

Precision Measurement: Unusual German Apparatus at the College of Aeronautics, Cranfield. I.—The Zeiss Instruments. S. C. Poulsen (*Aircraft Prod'n.*, 1948, 10, (113), 75-78).—P. describes three German precision measuring instruments: (1) Zeiss Diritest micro-hardness testing machine, (2) large Zeiss shop-microscope, and (3) large Zeiss universal measuring microscope. The Diritest machine is designed for non-destructive hardness testing using a very small diamond indenting point with a max. load of 200 g. Measurement of the width of the indentation is carried out using the attached microscope and micrometer eyepiece (overall magnification $\times 700$) with which readings to

0.0002 mm. (0.000008 in.) are possible. A fine-focusing control, graduated to read in 0.02 mm., is also provided and can be used for the measurement of thicknesses or depths by selective focusing. The large Zeiss shop-microscope is used for checking screw-threads, profiles, and angles, and for linear measurement; the large Zeiss universal measuring microscope has almost identical design features with the shop-microscope, but it has a much larger work-capacity and is equipped with movable carriages mounted in a massive base-casting.—W. A. M. P.

Portable Ultrasonic Thickness Gauge. Norman G. Branson (*Electronics*, 1948, **21**, (1), 88–91).—B. describes the Audigage—a thickness-measuring instrument relying on the principle of setting the metal wall into thickness vibration and determining the resonant frequency. An audible signal is used to indicate resonance. The theory of the resonance principle of thickness determination is given together with expressions for the velocity of longitudinal waves in the metal, and the fundamental and harmonic frequencies of vibration. This method does not provide an average thickness reading, only a reading for a very small spot under the transducer crystal. For this reason it cannot be used when considerable thickness variations exist. An expression,

$m = \frac{0.1}{f l}$ (where m = the max. slope in inches per inch, f = the max. ultrasonic frequency used for the thickness measurement, and l = the dimensions of the crystal in the direction of changing slope), gives the max. value of non-parallelism that can be measured. The extent and depth of erosion and corrosion pitting can only be determined over a relatively large area. An accuracy of 2–5% is claimed for the instrument when used on corroded metal and 1% on clean metal surfaces. The electrical principles are explained and circuit diagrams of the apparatus presented.—D. M. L.

Electronics in Metallurgical Research. E. V. Potter (*U.S. Bur. Mines Tech. Paper No. 661*, 1944, 30 pp.; (summary) *Instrument Practice*, 1948, **2**, (4), 151–152).—Items described by P. are: a form of self-balancing photo-electric potentiometer; a vacuum-tube oscillator; thermometric applications in the determination of transition points; measurement of changes in length and displacements—the coupled oscillator transducer; the use of two electric strain-gauges in a bridge circuit for dilatometric measurements; use of the electrostatic converter circuit in the measurement of damping capacity; application of sonics in metallurgy; the use of a cathode-ray oscillograph for tracing B - H curves; and induction furnaces.—P. L.

XIII.—PHYSICAL AND MECHANICAL TESTING, INSPECTION, AND RADIOLOGY

Hot Hardness Testing. Otto Zmeskal (*Metal Progress*, 1947, **51**, (1), 86).—The apparatus developed by Bishop and Cohen (*ibid.*, 1943, **43**, 414) for direct determinations of hardness at elevated temp., has been modified for routine work.—N. B. V.

The Significance of Mechanical Testing. H. E. Davies (*J. B'ham. Met. Soc.*, 1947, **27**, (4), 412–422; discussion, 434–442).—D. discusses the use of mechanical tests as acceptance tests for metals, with particular reference to ferrous materials. Such tests are usually three-fold: (a) a tensile test, (b) a ductility test, and (c) a shock-resistance test. D. considers each test separately and points out that (a) the normal tensile strength has little significance where notched parts are concerned, (b) the normal indexes of ductility do not reveal brittle conditions, and (c) the Izod test cannot be regarded as a criterion of shock resistance.—R. W. R.

Testing the Strength of Magnesium Die-Castings. (Fleischmann and Stone). See p. 531.

Fatigue Testing with Particular Reference to Tests at Elevated Temperature. J. McKeown (*J. B'ham. Met. Soc.*, 1947, 27, (4), 423–433; discussion, 434–442).—McK. reviews previous work on the effect of temp. on fatigue resistance and concludes that, at elevated temp. (1) there is no fatigue limit, (2) the frequency of the stress reversals is important, (3) the life depends on the mean stress, and if this is high enough creep may occur. He points out that service failures may occur under conditions of (a) specific stress, and (b) specific strain; the ordinary Wöhler test approximates conditions of specific stress, while the rotating-load Wöhler test is carried out under conditions of specific strain. These two tests normally give the same results, but under conditions where creep may occur, their indications may be different, a point which the designer using elevated-temp. fatigue-test data must bear in mind. McK. concludes with a description of a machine for high-temp. fatigue testing recently developed in the laboratories of the British Non-Ferrous Metals Research Association.—R. W. R.

†Stress Concentration and Fatigue Failures. Stepan Timoshenko (*Proc. Inst. Mech. Eng.*, 1947, 157, (28), 163–169), and (abridged) *Engineer*, 1947, 183 (4763), 398–399; (4764), 421–422).—T. discusses the problems of stress concentration and fatigue failures in connection with machine design from the viewpoint of the mechanical engineer and deals with the following methods of experimental stress analysis: (1) photo-elastic, (2) “stress coat”, and (3) resistance wire strain-gauges. The utilization of planned fatigue tests in conjunction with refined stress analysis is also discussed, and reference is made to the increase in fatigue strength resulting from cold working.

—W. A. M. P.

Electrical Resistance Wire Strain-Gauges to Measure Large Strains. K. H. Swainger (*Nature*, 1947, 159, (4028), 61–62).—“Minalpha” wire of 0.001 in. dia. has been found very suitable for use in strain-gauges: the electrical resistance-strain curve is linear up to strains of 7–8%, and sensitivity is adequate for the measurement of small strains.—M. A. V.

The Analysis of Strain and Its Graphical Representation. A. H. Willis (*Engineering*, 1948, 165, (4294), 457–460).—An introduction to the subject of strain analysis with particular emphasis on the graphical representation of strain. Graphical methods yield solutions quickly and assist in understanding the subject. To convert principal strains to principal stresses a nomogram can be employed.—R. Gr.

Development and Application of Electrical Strain-Gauges for the Measurement of Static and Dynamic Stresses. A. R. Anderson (*Schweiz. Arch. angew. Wiss. Techn.*, 1947, 13, (11), 321–334; discussion, 334–336).—[In German]. A. briefly traces the development of the use of strain-gauges and reviews methods and apparatus suitable for measuring both static and dynamic stresses. A number of typical applications of both kinds are described.

—R. W. R.

Testing Methods Using Pendulum Machines [for Machinability]. A. S. Kenneford (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 241–243; discussion, 267–291; and (summaries) *Engineering*, 1946, 161, (4197), 599–600; *Mécanique*, 1946, 30, (337), 223–224; *Aircraft Prod'n.*, 1946, 8, (93), 321–323; and *Machinery (Lond.)*, 1946, 68, (1758), 793–795; discussion, 796).

***Surface Analysis with Plastic Replicas.** A. J. Chisholm and J. M. Lickley (*Engineering*, 1948, 165, (4291), 389).—A description is given of a method of obtaining replicas with cellulose acetate and the errors which may arise are mentioned. An instrument for mounting the replica is illustrated and described to avoid waviness in the replica when measuring the roughness of the surface.—R. Gr.

Surface-Finish Measurement of Engineering Components. C. Timms (*J. Inst. Prod. Eng.*, 1947, **26**, (12), 411-426).—An account is given of the methods used at the National Physical Laboratory for measuring surface roughness.—J. C. C.

Magnetic-Particle Inspection of Chromium-Plated Tools. M. H. Mueller and W. E. Yeast (*Metal Progress*, 1947, **51**, (3), 420-425).—Hardened and ground tools which, before chromium plating, appeared quite sound when inspected by the magnetic-particle method were subsequently found to fail owing to the presence of fine surface cracks. Experiments showed that these cracks were formed during hard chromium plating and later inspection did not reveal them. M. and Y. describe how an epidemic of broken tools used in the manufacture of small-arms ammunition was overcome by changes in the equipment and technique of magnetic inspection and by giving the tools a low-temp. anneal (350° F.; 177° C.) which relieved strains without tempering the steel.—N. B. V.

Seven Jobs Saved in Inspecting Copper Wire Bars. — (*Eng. and Min. J.*, 1948, **149**, (4), 79).—A short and illustrated description of an arrangement of conveyers and men to effect saving in man-power.—R. GR.

Thickness Gauge for Moving Sheets. J. W. Head (*Electronics*, 1948, **21**, (5), 90-92).—H. describes the construction of an electronic instrument for determining the thickness of sheets of glass or non-magnetic materials. The sheets, which may vary in thickness between $\frac{1}{8}$ in. and 1 in., are run between the primary and secondary coils of a special transformer. The coupling between the coils is upset by thickness variations. A bridge circuit is used to operate a dial indicator or a high speed recorder. The sensitivity is claimed to be full-scale deflection with ± 0.0005 in. from the mean thickness.

—D. M. L.

Inspection. J. Wardell (*Machine Shop Mag.*, 1946, **7**, (4), 34-37).

The Inspection and Testing of Brazed Joints with Especial Reference to Silver Alloy Brazing. (Christie and Setapen). See p. 545.

RADIOLOGY

Radiography Reveals Internal Quality of Die-Castings. R. W. Dively (*Steel*, 1947, **121**, (18), 88-89, 121).—The appearance of defects as revealed by radiographs of die-castings is described and illustrated.—M. A. V.

Application of Recent X-Ray Inspection Equipment. J. L. Bach (*Machinery (Lond.)*, 1946, **69**, (1780), 663-665).

XIV.—TEMPERATURE MEASUREMENT AND CONTROL

Characteristics of Thermocouples. C. T. Weller (*Gen. Elect. Rev.*, 1946, **49**, (11), 50-53).—After a brief account of the thermo-electric effect, W. presents tables and graphs to illustrate the e.m.f.-temp. relation, departure limits, the operating ranges, and special applications of the following thermocouples: platinum/platinum-10% rhodium, Chromel/Alumel, copper/Copnic, iron/Copnic, and Chromel/Copnic.—D. M. L.

XV.—FOUNDRY PRACTICE AND APPLIANCES

Pilot Aluminium Plant for New-Product Development. J. T. Underwood (*Modern Metals*, 1948, 4, (3), 17–21).—Describes the operations in an experimental foundry set up by the Reynolds Metal Company for making castings required in development work.—N. B. V.

Sand, Gravity, or Pressure [for Aluminium Castings]? E. Carrington (*Light Metals*, 1947, 10, (117), 526–531).—A discussion of the factors affecting choice of method for aluminium castings.—F. A. F.

Problem of Gases in Copper, Brass, Gun-Metal, and Bronze. Andrzej Wójcik (*Hutnik*, 1946, 13, (12), 611–619).—[In Polish]. Published work on dissolved and occluded gases in copper and copper alloy foundry practice is reviewed, and measures for preventing blister and cavity formation in the castings are discussed.—R. T.

***Pressure-Tight Phosphor-Bronze Castings.** Richard H. Lambert and Vincent DePierre (*Foundry*, 1946, 74, (11), 66–67, 131, 134).—Pressure-tight castings in 88/9/3 phosphor bronze and 85/5/5/5 leaded gun-metal may be made using a melting technique, based on that originally suggested by Baker, Child, and Glaisher (*J. Inst. Metals*, 1944, 70, 373), in which the metal is melted under an oxidizing flux consisting of 50% copper oxide and 50% potassium nitrate (1 lb. flux per 100 lb. metal) and subsequently deoxidized by addition of 0.025% phosphorus. The authors present some experimental test results to substantiate their statements.—R. W. R.

Improvements in the Manufacture of Tin Bronzes. W. T. Pell-Walpole (*Metal Progress*, 1946, 50, (6), 1221–1231).—A summary of work carried out by P.-W. and reported fully in a series of papers in *J. Inst. Metals* (e.g. 1944, 70, 127; 1945, 71, 37, 267, &c.).—N. B. V.

Correspondence [on W. T. Pell-Walpole's Paper:] “Control of Gas Content in Bronzes.” K. I. Levanto (*Metallurgia*, 1948, 37, (221), 269).—Cf. *Met. Abs.*, this vol., p. 361).—L. directs attention to the difference of solubilities of atomic and molecular hydrogen in copper, and enquires as to the possibility of sulphur dioxide causing porosity. P.-W., in his reply, remarks on porosity caused by the oxidation of hydrogen by dissolved Cu_2O . He confirms that porosity due to sulphur dioxide is well known, but relatively harmless to mechanical properties.—M. A. V.

***Effect of Chills on Rate of Solidification of Gun-Metal.**—William J. Richmond (*Nassau*, 1948, 10, (4), 3–10).—Reprinted from *Foundry*, 1947, 75, (10), 72–73, 252, 254, 256; see *Met. Abs.*, this vol., p. 436.—S. G.

Impregnation of Magnesium Alloy Castings [—II]. Herbert Dobkin (*Foundry*, 1946, 74, (11), 84–85, 224, 226, 228, 230; and (abridged) *Metal Ind.*, 1947, 70, (21), 381–382).—Cf. *Met. Abs.*, this vol., p. 231. D. discusses the various methods available for the sealing of porous magnesium alloy castings and gives a full account of the styrene–linseed oil co-polymer (“Armetol”) process.—R. W. R.

[Discussion on Paper by A. Cracknell and F. Cousans:] “Some Notes on the Surface Drying of Moulds.” — (*Found. Trade J.*, 1947, 83, (1625), 157–159; (1626), 174–176).—Cf. *Met. Abs.*, this vol., p. 113.—J. E. G.

Pattern Equipment for Mechanized Production in a Light-Castings Foundry. James A. McIntosh (*Found. Trade J.*, 1947, 83, (1633), 327–330).—Read before the Scottish Branch of the Institute of British Foundrymen. An illustrated account of a method of making intricate pattern plates for the production of light castings on moulding machines.—J. E. G.

Match-Plate Patterns from Phenolic Casting Resin. C. R. Simmons (*Foundry*, 1946, 74, (11), 123–124, 126).—S. discusses the advantages of phenolic resins for the manufacture of match-plate patterns; principal

are lightness, cheapness, and superior pattern surface. The main disadvantage is the low strength of the resins, which often necessitates the use of reinforcement.—R. W. R.

***Gases Given Off by Core Binders.** Hiram Brown (*Light Metal Age*, 1947, 5, (6), 10–13).—Tests were carried out to determine the evolution of gas from cores of standard size in which binders of the linseed oil, petroleum, urea resin, and cereal types were used. Cereal flour binders gave off most gas, and there was not much difference between the other three types, linseed oil coming next to cereals. The test results are correlated with strength data, obtained in a previously reported series of experiments.—M. A. V.

Some Applications of Asbestos in the Foundry. F. J. McCulloch (*Found. Trade J.*, 1947, 83, (1632), 309–310).—Read before the Birmingham, Coventry, and West Midlands Branch of the Institute of British Foundrymen. An account of the use of asbestos yarn or sheet in the production of different types of castings.—J. E. G.

Foundry Practice : Developments During the Past Year as Described in the Literature. H. W. Lowrie, Jr. (*Metals Rev.*, 1947, 20, (4), 5–8).—References are given to abstracts published in *Metals Rev.*—S. G.

Equipment and Products for the Foundry Industry : Aids to Better Castings as Described by the Foundry Suppliers. — (*Metals Rev.*, 1947, 20, (4), 9–11, 14–15, 17).—Covers feeding compounds; furnaces, crucibles, and ladles; refractories; casting equipment; centrifugal casting; precision casting; mechanized equipment; core making; sand preparation; moulding equipment; dust control and ventilation; and miscellaneous equipment.—S. G.

The Scientist in the Foundry. C. R. Tottle (*Found. Trade J.*, 1947, 83, (1634), 347–349).—Read to the Newcastle-upon-Tyne Branch of the Institute of British Foundrymen. A review of the application of some typical methods of scientific procedure to foundry technology.—J. E. G.

Foundry Conditions, Personnel, and Production. R. F. Coates (*Found. Trade J.*, 1947, 83, (1634), 351–355; 84, (1635), 3–8; discussion, (1636), 35–37).—Read to the London Branch of the Institute of British Foundrymen. Suggestions for the practical implication of the Garrett Report.—J. E. G.

Motion Pictures to Teach Foundry Work. Seerley Reid (*Foundry*, 1946, 74, (11), 86–87, 200, 202, 204, 206).—An account of a film produced by the U.S. Office of Education.—R. W. R.

Foundry Furnaces. (—). See p. 532.

Centrifugal-Casting Copper-Spun Rotors. G. A. Anderson (*Steel*, 1947, 120, (17), 96–97, 126, 129).—Squirrel-cage rotors of electrolytic copper were cast centrifugally in one piece. The special requirements are enumerated, and casting technique described.—M. A. V.

Precision Centrifugal Casting of Small Parts. A. G. Arend (*Machinery (Lond.)*, 1946, 68, (1749), 504–505).

Precision-Investment Casting and Its Future. D. F. B. Tedds (*Found. Trade J.*, 1947, 83, (1631), 281–288, 290).—Read before the Bristol and West of England Branch of the Institute of British Foundrymen. A detailed account of the production of wax patterns and the investment assemblies. The casting process itself and factors affecting design are also discussed.

—J. E. G.

Precision-Investment Casting. Alexander Saunders (*Steel*, 1947, 120, (16), 92–94, 117, 120).—The applications of precision-investment casting are discussed, with examples, and current practice described generally.—M. A. V.

Precision Casting. — (*Elect. Rev.*, 1948, 142, (3660), 77–82).—A general illustrated account of the equipment at the Derby foundries of Rolls Royce, Ltd.—J. C. C.

Precision Castings in High-Melting-Point Alloys for General Engineering Purposes. Frank Hudson (*Metallurgia*, 1948, 37, (221), 243–247).—Presented

to the Midland Metallurgical Societies. The applications and technique of the "lost-wax" process are discussed from the point of view of the economical production of precision castings of alloy steels and other high-melting-point alloys.—M. A. V.

Commercial Possibilities of the Lost-Wax Process. A. Short (*J. Inst. Prod. Eng.*, 1948, 27, (2), 85–102 (including discussion).—A brief account is given of the process as applied to the production of castings in Vitallium and special steels. Details are included of the waxes and refractory investment materials employed and production costs for some typical castings analysed.—J. C. C.

Gas-Turbine Blading: Current American Practice Reviewed—Casting, Machining, and Fastening Methods. A. T. Colwell and R. E. Cummings (*Aircraft Prod.*, 1948, 10, (111), 24–28).—W. A. M. P.

The Die-Casting of [Aluminium Alloy] Chrysler Pistons. Raymond Guillemot (*Rev. Aluminium*, 1947, (132), 134–136).—An account of the methods used at the Detroit foundry of the Chrysler Motor Corporation is given, taken from an article by C. H. Wick in *Machinery* (N.Y.). Al–Si–Cu alloy is used for the pistons, which are heat-treated.—F. A. F.

Die-Casting Progress. IV.—Pressure Die-Casting of Magnesium Alloys. A. C. Street (*Metallurgia*, 1948, 38, (223), 3–5).—Cf. *Met. Abs.*, this vol., p. 300. Recent developments in the pressure die-casting of magnesium alloys in the U.K., U.S., and Germany are reviewed. The alloy most favoured contains aluminium 9, zinc 0.5, and manganese 0.25%. Some typical applications of magnesium alloy die-castings are described.—M. A. V.

Testing the Strength of Magnesium Die-Castings. Walter L. Fleischmann and George M. Stone, Jr. (*Die-Castings*, 1947, 5, (12), 25–26, 40–42).—The results obtained from a comparison of the physical properties of samples cut from actual production castings made by several die-casters are discussed. Three conclusions were reached: (1) The product of certain die-casters will have physical properties within a narrow range, while others produce castings of widely scattered physical properties. This variation must be made as narrow as possible. (2) The physical strength is fairly uniform and little influenced by the method of gating so long as a sound casting is produced. (3) Radiographic inspection, while showing the location and extent of internal imperfections, is not a positive indication of the strength of a section; possibly microporosity is an additional factor affecting the strength.—P. L.

***An Analysis of Surface Quality of Zinc-Base Die-Castings.** A. W. Sundick (*Steel*, 1947, 121, (11), 94–95, 136, 138–143).—An investigation into the causes of surface imperfections in zinc-base die-castings, of A.S.T.M.-Alloy XXV composition, showed that die design was an important factor. Bad design could cause "chills", splashing, gate-holes, cold laps, and swirls; and pressure losses must be minimized between the gauge on the hydraulic system and the far end of the casting. The best composition for castability was aluminium 3.9–4.3, copper 1.0–1.25, magnesium 0.03–0.04, lead, cadmium, and tin <0.003, and iron <0.05%.—M. A. V.

Advantages of Induction Furnaces in Zinc Die-Casting. Herbert Chase (*Steel*, 1947, 121, (19), 108–109, 136, 138).—The use of Ajax-Tama-Wyatt type L.F. induction furnaces for producing zinc die-castings is described. These have the advantage that the molten metal is kept out of contact with iron. Alloying constituents are conveniently added in the form of "hardener" rod. Electrically heated launders have been devised for transferring the molten alloy to holding furnaces.—M. A. V.

Gravity Die-Casting: A Review of Current Practice. Newman Field (*Machinery* (Lond.), 1946, 69, (1781), 701–704).

Selecting Steels for Casting Dies. Herbert Chase (*Steel*, 1947, 120, (2), 98, 100, 109).—The general requirements of die steels for casting non-ferrous alloys are outlined, and the special requirements for copper and zinc alloys

and light metals discussed. The compositions and applications of a few representative die steels are included.—M. A. V.

Weight Estimation for Die-Casting [—II]. H. K. Barton and L. C. Barton (*Machinery (Lond.)*, 1946, **68**, (1738), 159–161).—Cf. *Met. Abs.*, 1946, **13**, 61.
—S. G.

XVI.—SECONDARY METALS: SCRAP, RESIDUES, &c.

Reclamation of Aircraft Aluminium. G. W. Birdsall (*Metal Progress*, 1946, **50**, (6), 1232–1238); and (condensed) *Metal Ind.*, 1947, **70**, (8/9/10), 146–148; correspondence, (12), 185–186).—B. describes in some detail the methods of reclaiming aircraft scrap evolved by Reynolds Metals Co., by which charges consisting of 100% of scrap are melted down to yield a product that meets the original specification of the sheet from which the scrap originated, with a recovery of over 95% of the aluminium content. Sheet as thin as 0.020 in. can be successfully treated by this process, and there is no segregation of other metals beforehand. The scrap is melted down in an oil-fired, sloping-hearth furnace in which a reducing atmosphere is always maintained by supplying excess of oil. As soon as the aluminium melts it runs down the hearth into a holding basin where it is subsequently fluxed with chlorine to remove impurities. The melting and fluxing operations are carried on continuously and the metal is tapped off in 5000-lb. lots. Typical analyses of ingots made from 17S and 24S are given.—N. B. V.

Secondary Metal: How Statistics Can Control Quality [in Aluminium Alloys]. F. J. Erroll (*Light Metals*, 1947, **10**, (116), 436–438).—A description is given of the advantages of the application of the methods of statistical quality control to the recovery of secondary aluminium alloys.—F. A. F.

Sampling and Electrode Production for the Rapid and Reliable Determination of Compositions of Batches of Secondary Aluminium Alloys Cast as Small Ingots from Large Melting Furnaces. (Moritz). See p. 524.

The Fumes in the Metallurgy of Lead. E. González Francisco (*Ion*, 1946, **6**, 357–364, 371; *C. Abs.*, 1947, **41**, 66).—A descriptive study of lead-containing fumes, their analysis, and possibilities of reclaiming.

A Silver Recovery Plant—Before and After. — (*Plating*, 1948, **35**, (4), 354–357).—A brief but well illustrated description of a plant used for recovering silver from stripping solutions, &c.—G. T. C.

The Identification and Recovery of Scrap Metal. — (*Machinery (Lond.)*, 1946, **68**, (1754), 659–663).

XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

Foundry Furnaces. — (*Overseas Eng.*, 1947, **21**, (242), 158–164).—Brief descriptions are given, accompanied by illustrations, of 17 different furnaces designed for the melting of ferrous and/or non-ferrous metals and fired by either electricity, oil, coke, or gas. The capacity of each furnace is given, together with details of lining, output rating, and suitability for the melting of particular metals.—R. L. B.

***A New Carbon Resistor Furnace.** W. J. Kroll, A. W. Schlechten, and L. A. Yerkes (*Trans. Electrochem. Soc.*, 1946, **89**, 317–329; and (summary) *Metal Ind.*, 1946, **68**, (19), 363–364).

Vacuum Furnace Control. Frank F. Davis (*Electronics*, 1948, **21**, (5), 81).—D. describes a method of safeguarding the tungsten heaters against burn-out due to excessive gas pressure. Switching of the tungsten elements is automatically controlled by an electronic circuit in which a thermistor is

used as the sensing element. The thermistor operates a calibrated indicator and a relay in the current circuits.—D. M. L.

Advantages of Induction Furnaces in Zinc Die-Casting. (Chase). See p. 531.

Beating the Coke Shortage [Fuel Economy in Coke-Fired Furnaces]. — (*Foundry*, 1946, **74**, (11), 77, 161, 164).—A number of practical recommendations are made.—R. W. R.

Problems in Fuel Efficiency. C. Hulse and R. J. Sarjant (*J. Iron Steel Inst.*, 1946, **153**, 165–181 p; discussion, 199–216 p).—Problems in fuel efficiency relating to works at which processes may be specialized are discussed in relation to the bearing of fuel selection on efficiency, developments in furnace design and construction, methods of fuel saving in individual works, education, and research. The present position is reviewed, and lines of future development are suggested.—AUTHORS.

News Gleanings for the Refractories Industry. L. Sanderson (*Refractories J.*, 1948, **24**, (1), 33–37).—Items described include: reheating furnaces, the annealing of stainless-steel tubes, and aluminium furnace cement.—P. L.

XVIII.—HEAT-TREATMENT

Heat-Treating Schedules [for Aluminium Alloys]. J. Edwin Burkhardt (*Metal Progress*, 1947, **51**, (3), 442).—Normally, the alloys 14S and R301 are aged for 6 hr. at 350° F. (177° C.) and 53S and 61S for 8 hr. at that temp. B. states that economies can be effected by ageing all four alloys for 8 hr. at 350° F. or 10 hr. at 340° F. (171° C.).—N. B. V.

Practical Heat-Treatment of Aluminium and Its Alloys. Robert Gadeau (*Usine Nouvelle*, 1947, **3**, (23), 9).

***Annealing [Aluminium Die-Castings] for Stress Relief.** N. F. Ritchey and P. A. Berghorn (*Die-Castings*, 1947, **5**, (12), 28, 43–45).—An investigation of the effects of annealing on dimensional stability and machinability, with special reference to aluminium die-castings. Three distinct dimensional changes may occur: (1) distortion due to release of internal stresses, (2) simple expansion due to increase of temp., and (3) permanent growth at approx. 250° C. The stress-relief anneal contributes very little to castings, which from all indications are quite stable as cast.—P. L.

***Factors Involved in Heat-Treating a Magnesium Alloy [AZ92].** A. E. Flanigan, I. I. Cornet, R. Hultgren, J. T. Lapsley, and J. E. Dorn (*Metals Technol.*, 1947, **14**, (6); *A.I.M.M.E. Tech. Publ. No. 2282*, 37 pp.).—Tensile bars of AZ92 were solution heat-treated in a salt bath. Solution temp. from 770° to 775° F. (410°–413° C.) were found most suitable for treatment of tensile specimens. Lower temp. require longer times for homogenization; higher temp. also require a longer time and result in inferior properties. Local fusion occurs during solution treatment in the recommended temp. range, but it has no harmful effect on tensile properties and is not prevented by preheating. In the salt bath used, preheating was found to be of benefit only in cases in which the recommended temp. was exceeded. In such cases the damage occasioned by overheating was greatly reduced. Grain-boundary voids appear in polished specimens of the over-heated alloy; bars containing these voids have lower tensile properties. A coarse grain-size increases the time required for homogenization, and foundry control of grain-size is therefore important in castings destined for solution treatment. Cracks result from water quenching direct from the solution temp., but may be avoided by cooling to intermediate temp. below approx. 750° F. (399° C.) before quenching. Quenched above 715° F. (381° C.) prevents precipitation of the β -phase. With lower quenching temp., or air cooling, precipitation occurs. Bars

quenched from 715° to 750° F. (381°–399° C.) are similar in tensile properties to air-cooled bars after solution treatment; the importance of quenching lies mainly in its effect on ageing. Investigations on the precipitation-hardening showed that both lamellar and general types of precipitation are found in the aged alloy. The modes of precipitation appear to be essentially similar at all ageing temp. from 300° to 625° F. (149°–329° C.). For a given ageing temp. the tensile yield strength (*TYS*) attainable in fully aged bars increases with the proportion of the general precipitation produced. It decreases as the proportion of the lamellar type increases. The ratio of lamellar to general precipitate developed by ageing at a given temp. is influenced by the rate of cooling following solution heat-treatment. *UTS* (ultimate tensile strength) and *TYS* resulting from ageing may be improved approx. 10%, without loss of ductility, by substitution of a hot-water quench for the usual air cooling. The time required for ageing may be reduced by treating for 4–5 hr. at 375° F. (191° C.) instead of 18 hr. at 350° F. (177° C.); the tensile properties are similar. The degree of solution obtained prior to ageing is important; incomplete solution results in a reduction of the final tensile properties, but solution treatment prolonged beyond attainment of 98% solution is of no benefit. Grain-size should be carefully controlled; large grain-size makes it difficult to obtain max. tensile properties, mainly because solution heat-treatment is more difficult. Procedures recommended are: cool in furnace to 730° F. (387° C.) after solution heat-treatment, quench the work in boiling water, and age for 4–5 hr. at 375° F. (191° C.).—AUTHORS.

Heat-Treating and Machining Magnesium Alloys.—IV. Allen G. Gray (*Steel*, 1947, 120, (5), 102–104, 106).—Cf. *Met. Abs.*, this vol., pp. 35, 55, 57, 368, 369. The various methods of heat-treating magnesium casting alloys (solution, ageing, and stabilizing) are described, and machining technique is outlined.—M. A. V.

Salts for Heat-Treatment [and Soldering and Brazing]. Ernest Hague (*Metallurgia*, 1948, 38, (223), 39–43).—Applications of salt baths are briefly outlined: these include heat-treating aluminium alloys in a nitrate salt; aluminium brazing; silver soldering in a neutral salt; brass brazing in a cyanide mixture; and copper brazing in a neutral salt.—M. A. V.

Some Recent Heat-Treatment Furnace Installations. — (*Metallurgia*, 1948, 38, (223), 50–57).—Among the installations described are G.W.B. Electric Furnaces, Ltd., pusher furnaces for preheating light-alloy slabs; a twin-chamber batch-type furnace for annealing coils of aluminium strip; a conveyor-type furnace for “flash” annealing aluminium sheets, and a G.E.C. mesh-belt continuous furnace for copper brazing.—M. A. V.

Products and Processes for Heat-Treating: An Index to New Equipment Developed or Improved During the Past 12 Months. — (*Metals Rev.*, 1948, 21, (1), 13, 15, 17, 19).—S. G.

Annual Review of Electrical and Allied Developments. Industrial Equipment, Applications—Heating. — (*Gen. Elect. Rev.*, 1947, 50, (1), 25–26).—A brief review is given of developments in H.F. heating. Main advances described are the use of magnetrons for very high frequencies, mechanical-handling equipment for speeding up induction heating, and the use of mechanical-handling equipment in conjunction with dielectric heaters. Other sections deal with a controlled-atmosphere furnace equipment giving a gas free from carbon dioxide, a molybdenum-wound laboratory furnace giving temp. up to 1350° C., and midget 25-W. soldering irons suitable for instrument work.—D. M. L.

Problems in the Design of High-Frequency Heating Equipment. Wesley M. Roberds (*Proc. Inst. Radio Eng.*, 1946, 34, (7), 489–500).—The problem of efficient coupling between work coils of small dimensions and the high impedance radio-frequency generator is analysed by a simple mathematical

treatment. R. discusses various coupling methods commonly used and suggests a design for an efficient current transformer or concentrator enabling single-turn work coils to be coupled to the types of generators usually used in industry.—D. M. L.

High-Frequency Induction-Heating Equipment. — (*Overseas Eng.*, 1947, 21, (239), 62).—An equipment, manufactured for 1 or 5 kW. output, has been employed by A. C. Wickman of Coventry for soldering, brazing, hardening, and the heat-treatment of metals in selected locations. Automatic-feed mechanisms may be fitted to the separate worktable. Details of the components are given.—R. L. B.

Industrial Applications of R.F. Heating. — (*Overseas Eng.*, 1947, 21, (242), 172–173).—Three small low-power radio-frequency generators are described. Two of them, being of the induction-heater type, are suitable for heating metal and are contained in a fully screened aluminium cabinet. The other is a dielectric heater designed specifically for heating plastic moulding powders at a rate of 100° C./min. X-ray photographs are shown of brazed joints produced in the normal way and also by induction-heating methods. The induction heaters are also suitable for annealing, hardening, stress-relieving, and soldering.—R. L. B.

XIX.—WORKING

***Some Factors Affecting the Rate of Extrusion of Aluminium Alloys.** T. L. Fritzlen (*Trans. Amer. Inst. Min. Met. Eng.*, 1946, 166, 458–465; discussion, 466–472).—See *Met. Abs.*, 1946, 13, 105.—J. L. T.

***The Extrusion Process [Data for Copper Alloys].** W. W. Cotter and W. R. Clark (*Trans. Amer. Inst. Min. Met. Eng.*, 1946, 166, 447–457; discussion, 466–472).—See *Met. Abs.*, 1946, 13, 38.—J. L. T.

The Works Metallurgist in the Drop-Forging Industry. F. E. Stokeld (*J. B'ham. Met. Soc.*, 1947, 27, (4), 395–410).—Presidential Address. S. describes the duties of the works metallurgist in a works producing both ferrous and non-ferrous drop forgings and makes a number of observations with regard to the metallurgical aspects of forging practice.—R. W. R.

Works Practice in the Rolling and Extrusion of Aluminium. Alastair McLeod (*Sheet Metal Ind.*, 1948, 25, (249), 73–91; (250), 285–296; (251), 491–496, 508).—A full description is given of the Rogerstone works of the Northern Aluminium Company, Ltd. A detailed account is presented of the extrusion presses and heat-treatment arrangements. Reference is made to the electrical, gas, water, compressed-air, and soluble-oil services, and crane arrangements.—R. Gr.

***Hot Roll Forming of Various Aluminium Alloys.** George Sachs, George Espey, and G. B. Kasik (*Trans. Amer. Soc. Metals*, 1946, 37, 449–467).—Various aluminium alloys were roll formed to a hat section at temp. up to 350° F. (177° C.) and the minimum bend radii determined. The effects of heating on the tensile properties and the influence of forming temp. on spring-back were also observed. With increasing temp. of forming, alloys 75S-T and R301-T were much more easily formed. Provided that the alloys are not over-heated or maintained too long at the rolling temp., roll forming at these elevated temp. does not cause any decrease in their mechanical properties.—J. C. C.

***A Laboratory Evaluation of the Hot-Working Characteristics of Metals.** C. L. Clark and J. J. Russ (*Trans. Amer. Inst. Min. Met. Eng.*, 1946, 166, 736–748).—See *Met. Abs.*, 1946, 13, 139.—J. L. T.

New Brake Cuts Aluminium Foil Costs. — (*Modern Metals*, 1948, 4, (1), 16–17).—A new type of air-operated tension brake for use on aluminium foil mills, double spoolers, spooler and trimmer machines, &c., is described

and illustrated. It practically eliminates foil breakage due to variations in tension and reduces the time required for re-threading.—N. B. V.

Rolling and Forming of Metal: Developments During the Past Year as Described in the Literature. H. Maurice Banta (*Metals Rev.*, 1947, 20, (11), 5-6, 55).—Covers developments in the rolling of seamless pipe, cold rolling of strip, cold and hot extrusion, Kirksite (aluminium 3.5-5.0, copper 4.0, magnesium 1%, rest zinc) alloy dies, and the forming of light alloys.—S. G.

Equipment and Processes for Rolling, Forging, and Presswork: Manufacturers Describe New Methods and Products for High-Speed Metal Fabrication. — (*Metals Rev.*, 1947, 20, (11), 8-9, 11, 13, 15, 17).—S. G.

†**The Rolling of Metals: Theory and Experiment. XV.—Discussion of Certain Practical Rolling Problems in the Light of the Theory of Rolling.** L. R. Underwood (*Sheet Metal Ind.*, 1948, 25, (250), 297-302, 308).—Cf. *Met. Abs.*, this vol., p. 303. Roll camber and deflection are discussed. Consideration is also given to the shape of rolls for special conditions, such as pre-loaded mills and rolls for very narrow strip.—R. Gr.

†**The Rolling of Metals: Theory and Experiment. XVI.—A Survey of Present Knowledge and the Direction of Future Research.** L. R. Underwood (*Sheet Metal Ind.*, 1948, 25, (251), 497-502; (252), 704-706, 716; (253), 917-921).—Cf. preceding abstract. The most useful contributions to the subject of rolling are stated to be the theory of the friction hill and the experimental determination of the pressure distribution in the arc of contact. An indication is given of the connection of the friction-hill theory with most of the quantities involved in rolling. The qualitative and quantitative use of the theory are discussed. Suggestions are given of the various aspects where further investigations are required and the information at present known is summarized under the following headings: (a) flow of material in rolling, (b) resistance to deformation and the criterion of plastic yielding of the material rolled, (c) lateral spread, (d) friction between the rolls and material, and (e) roll flattening. Brief notes refer to the problems involved in the measurement of roll load, torque, and tension. Instruments used for these measurements are reviewed and their limitations discussed. The series is concluded.—R. Gr.

***Calculation of Rolling Loads and of Rolling Power in the Light of Experimental Results.** A. Geleji (*Schweiz. Arch. angew. Wiss. Techn.*, 1947, 13, (11), 336-344).—[In German]. In a mathematical treatment of the problem of rolling, G. derives formulæ for the rolling load and power required. The following assumptions are made: (a) the rolls are cylindrical, (b) the material being rolled is rectangular, (c) no lateral forces are exerted, (d) the metal passes between the rolls with uniform velocity, and (e) the deformation resistance and coeff. of friction are const. over the working surfaces of the rolls. The rolling load P is given by $P = k \cdot b \cdot l$, and the power required L is expressed as $L = F \cdot k \cdot v + k \cdot b \cdot l \cdot \mu \cdot v (1 - h_2/h_1 \cdot \sec \alpha)$, where b = breadth of the strip being rolled, l = length of the arc of contact, F = the reduction in cross-section, v = velocity with which the strip passes between the rolls, μ = coeff. of friction, α = angle subtended at the roll centre by the arc of contact, and h_1 and h_2 are respectively the initial and final thicknesses of the strip. The quantity k , the resistance to deformation during rolling, is given in a third equation: $k = k_f (1 + 5.5 \mu \cdot l/h \cdot \sqrt{v})$ in which k_f = the resistance of the material being rolled to unidirectional compression. G. demonstrates the correctness of his equations by comparison with experimental results obtained by other authors.—R. W. R.

The Shaping of Metals: Progress in Hot Working, Cold Forming, and Machining, Indicated by an Analysis of a Year's Technical Literature. Francis W. Boulger (*Metals Rev.*, 1948, 21, (3), 3, 5, 7).—A review, with references to the brief abstracts published in *Metals Rev.*—S. G.

Production Processes : Their Influence on Design. X.—Roll Forming.

Roger W. Bolz (*Machine Design*, 1946, 18, (4), 167–172).—Cf. *Met. Abs.*, 1946, 13, 339.—S. G.

Production Processes : Their Influence on Design. XI.—Contour Sawing.

Roger W. Bolz (*Machine Design*, 1946, 18, (5), 117–122).—Cf. preceding abstract.—S. G.

Wire Drawing. H. Richards (*Mech. World*, 1948, 123, (3195), 407–410).

Presented to the Sheffield Section of the Institution of Production Engineers, 11 Feb. 1948.—S. G.

Back-Pull Wire Drawing : A Critical Review of Literature. J. G. Wistreich

(*Wire Ind.*, 1948, 15, (171), 177–180; (172), 253–255).—From *J. Iron Steel Inst.*, 1947, 157, 417–428; see *Met. Abs.*, this vol., p. 303.—S. G.

Diamond Dies for Wire Drawing. (Sir) Clifford Paterson and R. E. Leeds

(*Research*, 1947, 1, (1), 2–10).—A general description of the manufacture of diamond dies, especially for the production of very fine wire. The selection of suitable stones is described; stones exhibiting twinning are not used for dies. No optimum crystallographic direction has been found for ease of piercing or for increased die life. The diamond powders used to arm the needle drill are accurately graded by sieving, elutriation, and centrifuging. A description is given of the special-purpose machines used for grinding, drilling, and mounting, and their operation.—F. A. F.

Drawing Aluminium Tubing. Chas. T. Flachbarth (*Modern Metals*,

1948, 3, (12), 20–21).—A short, illustrated account, without much practical detail, of drawing practice in an American plant. A number of recent applications of aluminium alloy tube are mentioned.—N. B. V.

[Nickel and Monel Metal] Double-Wall Tubing. — (*Steel*, 1947, 120, (4),

76, 120–121).—Properties and standard sizes of “Bundyweld” nickel and Monel metal tubing are given, and the manufacture of double-walled tubing briefly outlined.—M. A. V.

***Effect of Spacing Between Dies in the Tandem Drawing of Tubular Parts.**

George Sachs and George Espey (*Trans. Amer. Soc. Mech. Eng.*, 1947, 69, 139–143).—In the drawing of tubular parts over a mandrel, several dies in tandem are often used to perform greater total reductions. The results of the investigations reported in this paper show the importance of a sufficiently large spacing when drawing tubular parts with a tandem-die arrangement. The total reductions achievable with a given spacing are a maximum if the first reduction is as close as possible to the max. reduction obtainable with a single die. A spacing close to three times the diameter of the draw-piece will give substantially the same total reduction as two single draws for any tubular part having an initial wall thickness of <10% of its diameter. For tubular parts having a very thin wall, the required spacing might even be smaller than three times the diameter.—AUTHORS.

Folding in Tube Sinking. George Sachs and W. M. Baldwin, Jr. (*Trans.

Amer. Soc. Mech. Eng., 1946, 68, 647–654).—An experimental study was made of the folding tendency of tubes during the process of sinking. It was found that tubes with a fold-free point, having a wall thickness of less than 1% of the diameter can be sunk without folding. However, if it is attempted to sink tubes with points containing folds beyond a certain critical reduction, the fold contained in the point will be perpetuated throughout the length of the tube. This critical reduction increases almost linearly with the ratio of thickness to diameter of the tube, and is little affected by the die angle, the metal, and its temper. The length of the fold during its formative period is found to increase with increasing reduction, with decreasing relative thickness, and to be relatively unaffected by die angle. The stress required to sink a tube with folds was found to increase only slowly beyond the limiting stress for sinking such a tube without folding to the smallest possible diameter.—AUTHORS.

***Stress Analysis of Tube Sinking.** George Sachs and W. M. Baldwin, Jr. (*Trans. Amer. Soc. Mech. Eng.*, 1946, **68**, 655-662).—Cf. preceding abstract. A theoretical stress analysis was made of the tube-sinking operation, equations being set up to yield the sinking stress as a function of the reduction in mean diameter. The equations were confirmed by experiment on annealed and full-hard copper and on annealed tube brass for conical dies of various tapers. The coeff. of friction existing during tube sinking were determined and were found to be of the same magnitude as those previously determined for wire drawing.—AUTHORS.

The Production of Aluminium Hollow-Ware. — (*Machinery (Lond.)*, 1946, **69**, (1782), 715-720).

Metal Spinning. I. A. Shepard (*Modern Metals*, 1948, **4**, (1), 28-29).—A brief description of the process.—N. B. V.

New Methods of Metal Spinning. E. Weiss (*Machinery (Lond.)*, 1946, **68**, (1748), 457-462).

***Stretching Characteristics of Aluminium Alloy Sheet.** J. M. Taub (*Light Metal Age*, 1947, **5**, (11), 6-13).—Stretch-forming tests were carried out on aluminium alloy sheet, using punches of various shapes. The alloys tested were bare and clad 24S-O and 24S-T, and bare 52S-O, 61S-O, and 61S-W. The minimum stretch was found in the area of sheet in contact with the punch, and the max. stretch between the punch and the grip. Both depended on the ratio metal thickness : gripping radius, frictional conditions and lubrication, the temper of the metal, and edge conditions. Stretched parts with a contour varying only slightly over the length tend to fail in the free area between punch and grip; if the contour is much sharper at the centre of the punch, they tend to fail at that point.—M. A. V.

†Forming of the Aluminium Alloy 75S. George Sachs and George Espey (*Trans. Amer. Soc. Metals*, 1946, **37**, 468-496).—Experience of aircraft manufacturers in forming 75S alloy sheet in various conditions of heat-treatment is summarized. At room temp. the ductility of heat-treated 75S-T is lower than that of 24S-T, and forming should generally be confined to annealed or quenched material (75S-O or 75S-AQ). At 250°-400° F. (115°-205° C.) 75S-T can, however, be formed as readily or better than 24S-T by such processes as bending, dimpling, or joggling. On the other hand, since the elongation is not increased, high temp. may be detrimental for operations such as stretch forming, beading, and the curving of stringers with thin sections in tension. The strength of 75S-T is not reduced by heating to 205° C. for short intervals.

—J. C. C.

Forming Magnesium Alloys.—VIII. Allen G. Gray (*Steel*, 1947, **120**, (16), 91, 126, 128, 130, 132, 134).—Cf. *Met. Abs.*, this vol., p. 549. The hot and cold working of magnesium alloys is discussed generally, and details are given of cutting and deep-drawing practice.—M. A. V.

Forming Magnesium Alloys.—IX. Allen G. Gray (*Steel*, 1947, **120**, (17), 105-106, 138, 140, 145-146).—Cf. preceding abstract. Technical data are given for hot drawing; and hand- and stretch-forming, extrusion bending, spinning, and forging techniques are outlined.—M. A. V.

***Forming Magnesium and Aluminium [Comparative Tests on Rubber Press].** — (*Aircraft Prodn.*, 1948, **10**, (114), 138).—A note on an investigation comparing the properties of aluminium alloys and magnesium alloys with special reference to beading, stretch flanging, and shrink flanging at elevated temp. with a rubber hydropress. Magnesium alloys exhibit greater formability than aluminium alloys at elevated temp. in the three forming operations studied. Aluminium alloys and magnesium alloys exhibit approx. the same bead formability at room temp. There is no comparison between the stretch-flange formability of aluminium and magnesium alloys at room temp. as a flange can be formed on all the aluminium alloys and on none of the magnesium

alloys. A relative comparison between the shrink-flange formabilities of the two materials can be made by comparing the reciprocals of the yield strengths of the alloys. The formability of magnesium alloys in general increases with temp. in the three forming operations, whereas the formability of aluminium alloys decreases with increase in temp. in beading and shrink flanging and increases only slightly in stretch flanging.—W. A. M. P.

Deep Drawing of Magnesium [Alloys]. R. G. Gillespie (*Machinery (Lond.)*, 1947, 71, (1824), 395–403).—Dies and equipment used in producing typical deep-drawn products such as instrument boxes and oxygen-bottle shells from magnesium alloy sheet are illustrated and described. The sheet and dies are heated to 300°–650° F. (150°–340° C.). “Spring-back” may prove troublesome if the working temp. is <450° F. (230° C.).—J. C. C.

Shop Handling of Magnesium. Gilbert C. Close (*Light Metal Age*, 1947, 5, (11), 22–23).—A general outline of the storage, handling, and fabrication of magnesium alloy sheet (FS-1) by the Northrop Aircraft Co.—M. A. V.

[Discussion on L. A. Carapella and W. E. Shaw's Paper:] “A Process of Augmenting Cold Drawability of the Magnesium +1.5% Manganese Alloy.” — (*Metals Technol.*, 1947, 14, (5); *A.I.M.M.E. Tech. Publ.*, No. 2222, 10–11).—Cf. *Met. Abs.*, 1947, 14, 407.—J. L. T.

Strain Measurements in Deep Drawing. K. L. Jackson (*Sheet Metal Ind.*, 1948, 25, (252), 723–724).—A description is given of a method of assessment of blank profiles. The plastic strain encountered in drawing is measured after fixing photo-grids directly on to the unformed blank. The distribution of the strains may be plotted.—R. GR.

Basic Dies for Deep Drawing. Chester A. Gray (*Machinist (Eur. Edn.)*, 1946, 90, (31), 1230–1232).

New Developments in Tungsten Carbide [Use in Punches and Dies]. A. R. Zapp (*Wire and Wire Products*, 1947, 22, (8), 591–593, 612–614).—Punches of tungsten carbide with 3% cobalt binder have given good service for compacting a phenol-aldehyde compound at 150° C. when provided with a copper plug to conduct away excessive heat. Tungsten carbide has been used for extrusion dies for aluminium at 425°–480° C., as deep-drawing dies for forming cups, blanking and cupping dies, cut-off dies for nails, rolls for edging sheet and flattening wire, and heading punches for cold-headers.—J. C. C.

Presses and Tools: New Equipment for Shaping and Cutting of Metals, Introduced During the Past Year, as Described by the Manufacturers. — (*Metals Rev.*, 1948, 21, (3), 9, 11, 13, 15, 17, 19, 21, 23.).—S. G.

[Further Discussion on] “Lubrication in Drawing Operations: Symposium.” E. A. Smith (*Sheet Metal Ind.*, 1948, 25, (251), 517–518).—Cf. *ibid.*, 1948, 25, (249), 95–98; *Met. Abs.*, this vol., p. 304. S. discusses the function of graphite as a lubricant in drawing operations.—R. GR.

Drawing Compounds Improve Press Potentials. Sam Spring (*Machinist (Eur. Edn.)*, 1947, 91, (7), 205–216).—Discusses what happens when sliding metal surfaces contact under high pressures. Friction, welding, the composition and application of modern drawing lubricants, chemical and physical tests suitable for production shops, and recommendations for steels, aluminium, and magnesium are covered.—S. G.

Ball-Pen Tubular Parts Rotary-Sliced to Length. John W. Dean, Jr. (*Machinist (Eur. Edn.)*, 1947, 91, (8), 248–250).—Burs and distortion are overcome by rotary knives that quickly cut gold, gold-filled, and steel tubing for pen and pencil bodies and caps.—S. G.

Pre-Cutting of Aluminium Houses. W. J. Granberg (*Light Metal Age*, 1947, 5, (11), 14–16).—A brief description of the design of parts of aluminium houses, and of cutting operations.—M. A. V.

The Sawing of Light Alloys. G. Laval (*Machines et Métaux*, 1947, 31, (346), 184–189).—A study of the forms of the saws.—M. E.

Heavy Cuts on Light Alloys. H. Eckersley (*Aircraft Prodn.*, 1948, 10, (113), 105).—Short critical note on the machining of light alloys with carbide tools. Although cutting speeds of up to 19,000 ft./min. on light alloys were used in war production the upper limit has never been determined as no machine tool has been designed that will exploit tungsten carbide tools to their full capacity.

—W. A. M. P.

Machining Magnesium Alloys.—V. Allen G. Gray (*Steel*, 1947, 120, (6), 100–102, 111–112).—Cf. *Met. Abs.*, this vol., p. 534. Details are given of recommended technique for shaping and planing, milling, drilling, reaming, tapping and threading, counter-boring, and sawing.—M. A. V.

Heat-Treating and Machining Magnesium Alloys.—IV. (Gray). See p. 534.

The Exaggerated Fire Hazard of Magnesium. Carl J. Lamb (*J. Amer. Soc. Naval Eng.*, 1947, 59, (4), 486–488).—A brief account of the properties, uses, and working of magnesium and magnesium alloys with special reference to the fire hazard. This danger is exaggerated and can be greatly reduced if the safe-handling methods developed by the magnesium industry are used and followed in detail.—W. A. M. P.

The Mechanics of the Cutting Operation. R. N. Arnold and G. A. Hankins (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 238–240; discussion, 267–291; and (summary) *Engineering*, 1946, 161, (4196), 574–576).

Tool Wear as a Measure of Machinability. E. Eatough (*Machinery (Lond.)*, 1946, 68, (1758), 792–793; discussion, 796; and *Engineering*, 1946, 161, (4198), 622–623).—Summary of a paper presented at the Institution of Mechanical Engineers' Symposium on Machinability, May 1946.—W. G. A.

Standardization of Tools for Machinability Tests. C. H. Booth (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 246–247; discussion, 267–291; and (summary) *Engineering*, 1946, 161, (4197), 595–596).

A Tentative Method of Assessment of Machinability. C. W. George (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 248–255; discussion, 267–291; and (summary) *Engineering*, 1946, 161, (4198), 621–622; *Aircraft Prodn.*, 1946, 8, (93), 321–323; and *Machinery (Lond.)*, 1946, 68, (1758), 795–796; discussion, 796).

Tool Materials [for Metal Machining]. J. E. Attwood (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 260–261; discussion, 267–291).

Cutting Fluids, Chipbreakers, &c. [for Machining Operations]. W. A. Carter (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 261–263; discussion, 267–291).

[Machinability and] Heavy Engineering. G. M. Baker (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 263–264; discussion, 267–291; and (summary) *Engineering*, 1946, 161, (4198), 605).

[Machinability and] Medium Engineering. L. Johnstone (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 264–265; discussion, 267–291; and (summary) *Engineering*, 1946, 161, (4198), 606).

[Machinability and] Light Engineering. P. C. Redwood (*Proc. Inst. Mech. Eng.*, 1946, 155, (20), 266; discussion, 267–291).

Tapping Speeds for Various Materials. — (*Machinist (Eur. Edn.)*, 1946, 90, (19), 809, 811).

Boring Oil-Impregnated Bronze Bushes. F. E. Browne (*Machine Shop Mag.*, 1946, 7, (4), 70).

Drilling, Reaming, and Facing Zinc Alloy Die-Casting. — (*Machinery (Lond.)*, 1946, 68, (1742), 285–287).

Air Control for Machining Die-Castings. — (*Die-Castings*, 1947, 5, (11), 58–62).—The majority of die-castings require some machining, and it is possible to increase the speed and volume of these operations by a combination of tooling ingenuity and the simple mechanism of air-operated feeds. Various types of equipment are discussed.—P. L.

XX.—CLEANING AND FINISHING

Cleaning Aluminium. J. S. Brady (*Metal Ind.*, 1947, **70**, (20), 358–360).—An abridged version of an article in *Iron Age*, 1946, **158**, (25), 76–79; see *Met. Abs.*, 1947, **14**, 138.—J. L. T.

***On the Mechanism of Metal Cleaning.** Samuel Spring and Louise F. Peale (*Metal Progress*, 1947, **51**, (1), 102–106; and (abridged) *Products Finishing*, 1947, **11**, (9), 94–96).—The mechanism of metal cleaning has been studied by direct visual and photographic observations, particularly under the microscope, of the process of oil removal from metal. This work, together with the results of earlier observations by the authors, fails to support the view that saponification and emulsification are important factors in metal cleaning, and shows that commercial practices based on this view are faulty and inefficient. Thus, it is not necessary to add large quantities of alkali to cleaning tanks to increase the saponification of the oil; it is much better to add a surface-active agent to undercut the oil globules. Nor is it necessary to change the cleaning solution as soon as oil appears on its surface, as this does not indicate that the solution has lost its emulsifying power.—N. B. V.

Detergents, Wetting, and Emulsifying Agents: Their Use in Metal Cleaning. P. D. Liddiard (*Metallurgia*, 1948, **38**, (223), 37).—Digest of a paper presented at a symposium on "Detergents, Wetting, and Emulsifying Agents", held by the London Section of the Society of Chemical Industry, 5–6 April 1948.

—M. A. V.

Wetting Agents in Industry. — (*Tin Printer*, 1947, **23**, (273), 14).—S. G.

De-Rusting by Electrolytic Action. — (*Overseas Eng.*, 1947, **21**, (241), 112–113).—A process has been developed to remove rust and other corrosion products from metals without interfering with the metal underneath. The articles are immersed in an alkali bath and a low-voltage electric current is passed through them. This treatment loosens the surface deposit but does not attack the sound metal, although the exposed surface may be pitted with corrosion. The process has been successfully operated on all metals except aluminium, and sand has been removed from intricate castings by this treatment.—R. L. B.

***Electroplating and Cathodic Pickling as Causes of Hydrogen Embrittlement [of Stainless Steel].** (Zapffe and Haslem). See p. 515.

The Cleaning of Metals. V.—Mechanical Cleaning Machines. R. Groves (*Metallurgia*, 1948, **37**, (221), 267–268).—Cf. *Met. Abs.*, this vol., p. 370. Concluding his series of articles, G. discusses the design and construction of simple cleaning tanks, mechanical washers, and electro-cleaning tanks.

—M. A. V.

Keep Air Clean [in Metal Treatment]. C. H. Mehaffey (*Machinist (Eur. Edn.)*, 1947, **91**, (8), 251–253).—Discusses the permissible safe concentrations of air contaminants in the metal industry and methods of control.—S. G.

Industrial Wastes: Waste Pickle Liquor. Richard D. Hoak (*Indust. and Eng. Chem.*, 1947, **39**, (5), 614–618).—No completely satisfactory process for the treatment of waste pickle liquor is yet available, but H. concludes from recent research that such a process can be developed. The various processes so far proposed are classified and briefly described.—D. P. M.

Industrial Wastes: Brass and Copper Industries. William S. Wise, Barnett F. Dodge, and Harding Bliss (*Indust. and Eng. Chem.*, 1947, **39**, (5), 632–636).—Cf. preceding abstract. A survey of the acid and total metal loss involved in a brass and copper plant revealed the following figures:

	Acid, %.	Total Metals, %.
In rinse waters	88.5	90
In spent pickle	9.6	3.8
In spent bright dip	1.9	6.2

The effect of the wastes on waterways is discussed, and research is being carried out both to reduce pollution and to recover by-products. During the bright-dipping process, hexavalent chromium is reduced to trivalent form, and a flow sheet, indicating the various steps necessary in the reverse or regeneration process, is given. There are difficulties still to be overcome in this method, and a flow sheet of an (as yet uncompleted) alternative treatment of wastes is presented.—D. P. M.

Selection and Application of Mechanical Finishes for Aluminium. Ralph E. Pettit (*Steel*, 1947, **120**, (11), 98–100, 115, 118).—The various mechanical methods of finishing aluminium (including polishing, satin finishing, fluting, sand-blasting, "high-lighting", ball burnishing, and preparation for painting) are described.—M. A. V.

How to Select Coatings for Aluminium. Ray Swan and N. P. Ruther (*Steel*, 1947, **120**, (12), 78–79, 97, 100).—The suitability of various finishes on aluminium for a number of applications is discussed.—M. A. V.

Black-Oxide Coatings on Copper and Brass [Die-Castings]. — (*Die-Castings*, 1947, **5**, (12), 55–57).—Describes the use of an aqueous solution of salts, consisting principally of sodium chlorite and alkali, to produce a superior type of black-oxide coating on copper and copper alloys containing 60% or more of copper.—P. L.

Simple Dip Finish [for Die-Castings]. — (*Die-Castings*, 1947, **5**, (12), 59–61).—The production of a low-cost finish for die-castings by zinc plating followed by a special clear dip is described. A clear conversion coating of zinc oxide and zinc chromate is formed.—P. L.

The Decoration of Tinplate. T. Fielding (*Tin Printer*, 1948, **24**, (276), 10, 12; (277), 8–9).—S. G.

Infra-Red Heating and the Metal Decorator. Malcolm Boyd (*Tin Printer*, 1947, **23**, (271), 8–9).—S. G.

1947 Progress in Metal Finishing. Walter A. Raymond (*Metal Finishing*, 1948, **46**, (1), 56–60).—A brief review of various theoretical and practical developments. 74 references are given.—G. T. C.

Cleaning, Finishing, Plating : New Developments and New Applications—a Review in Three Parts. C. A. Snavely. E. L. Combs. W. H. Safranek (*Metals Rev.*, 1947, **20**, (6), 5–8, 47).—C. A. S. deals with the cleaning of metals; E. L. C. with metal finishing; and W. H. S. with electroplating. The brief articles are essentially guides to abstracts published in *Metals Rev.*—S. G.

Equipment for the Finishing Department : 149 New Products and Processes for Metal Cleaning, Rust-Proofing, Coating, and Plating. — (*Metals Rev.*, 1947, **20**, (6), 9–15).—Covers tumbling; metal-washing machines; cleaning compounds; rust-proofing and phosphate coatings; zinc coatings—chromating; finishes for aluminium; miscellaneous protective coatings; enamels, lacquers, and plastics; metal spraying; electroplating; plating machines and barrels; anodes and racks; and dust control.—S. G.

A Review of Metal Polishing. L. Mable (*J. Electrodepositors' Tech. Soc.*, 1948, **23**, 91–94).—The process is briefly considered under the headings: personnel, conditions in the shops, outdoor metal finishes, automatic polishing machines and their future, back-stand polishing lathes, calico mops, and designs.—G. T. C.

An Analysis of the Polishing Problem. W. H. Sawyer (*J. Electrodepositors' Tech. Soc.*, 1948, **23**, 59–78).—S. points out the need for an organized approach and investigation of the many problems involved in polishing. He discusses these problems under the following headings: (1) design, (2) problems from the foundry and forge, (3) from the ingot and billet foundry and rolling mill, (4) from the press shop, (5) from the machine shop, (6) from the soldering and brazing departments, and (7) from the plating shop. He makes suggestions as to how work in other departments can be modified in order to give

the polisher a better chance of producing the best work. He also considers various matters connected with the polishing shop itself, such as design of equipment and automatic polishing.—G. T. C.

Methods and Technique of Automatic Polishing. H. C. Clements (*J. Electrodepositors' Tech. Soc.*, 1948, 23, 79–90).—C. reviews the various types of machine which are available under the headings: (a) special-purpose machines, (b) semi-automatic machines, and (c) fully automatic machines. Under (a) he describes tube, strip, and sheet polishing machines. Under (b) he discusses machines which will handle a limited range of articles and only require semi-skilled labour to operate them. Details of the output of some of these machines are given. Under (c) are reviewed machines which are built to carry out the full sequence of operations from the initial roughing to the final polishing required for plating purposes. It is stressed that careful investigation is needed in choosing bobs, brushes, and mops for automatic polishing. In the present state of development of automatic polishing, finishes of the standard obtained by the skilled polisher are difficult to maintain.—G. T. C.

Using Abrasive Belts for Buffing and Polishing.—V. John E. Hyler (*Steel*, 1947, 120, (2), 84–85, 109).—Cf. *Met. Abs.*, this vol., p. 66. A review of the design, choice of abrasive, and applications of polishing belts.—M. A. V.

Automatic and Semi-Automatic Buffing and Polishing. John E. Hyler (*Steel*, 1947, 120, (3), 84, 87–88).—Cf. preceding abstract. A description of machines and their applications.—M. A. V.

Practical Facts About Polishing and Buffing Compounds. Howard J. McAleer (*Proc. Amer. Electroplaters' Soc.*, 1946, 285–293; and *Die-Castings*, 1947, 5, (10), 62–64; (12), 62–66).—Discusses briefly the operations of polishing and buffing and considers the properties of individual abrasives and binders. Liquid buffing and polishing compounds for spray-gun application are also mentioned.—G. T. C.

The Electrolytic Polishing of Brass Pressings. P. Berger (*Sheet Metal Ind.*, 1947, 24, (248), 2437–2443).—Presented at the Third International Conference on Electrodeposition. B. gives an account of the industrial technique.—R. Gr.

Some Special Applications of the Electrolytic Polishing of Metals [Zinc Alloys and Lead Alloys]. H. C. J. de Decker, A. P. Krijff, and J. M. Pluut (*Sheet Metal Ind.*, 1947, 24, (247), 2235–2242).—Presented to the Third International Conference on Electrodeposition. Details of the technique are presented.—R. Gr.

Some Technical Applications of the Electrolytic Polishing of Metals. R. E. Halut (*Sheet Metal Ind.*, 1948, 25, (249), 113–121, 124).—Presented at the Third International Conference on Electrodeposition. A review of recent work is given and special reference made to the dangers of baths containing perchloric acid.—R. Gr.

Electropolishing—What Is Its Status To-Day? Charles L. Faust (*Proc. Amer. Electroplaters' Soc.*, 1946, 49–73).—The history, limitations, and advantages of electrolytic polishing are considered, and a list of patents is given. Details are presented of solutions and operating conditions for polishing the following: stainless steels, carbon and alloy steels, nickel, copper, brass, Monel metal, nickel silver, and aluminium. Brief mention is made of polishing zinc, cadmium, silver, lead and its alloys, tin and its alloys, and magnesium. Costs are briefly considered.—G. T. C.

Electropolishing—A Survey [—II]. Samuel Wein (*Metal Finishing*, 1948, 46, (4), 76–82).—A discussion of the applications and limitations of various types of bath, namely perchloric acid, phosphoric acid–chromic acid, sulphuric acid–phosphoric acid, sulphuric acid–citric acid, fluoride, arsenic acid, and complex phosphoric acid baths. Special problems are considered

in connection with the electropolishing of stainless steel, carbon and alloy steels, nickel, copper, brass, Monel metal and nickel silver, aluminium, zinc, cadmium, silver, lead and tin and their alloys, and magnesium. Operating data for electropolishing are given, including information on cathodes, anode-cathode spacing, tanks and auxiliary equipment, racks, agitation, time required, control, costs, &c.—G. T. C.

Precision Tumbling Metal Parts. R. M. Lord (*Steel*, 1947, **121**, (24), 93-94, 124).—Abrasive tumbling is applicable to brass, bronze, and other non-ferrous metals. Alundum is recommended as an abrasive.—M. A. V.

Barrel Finishing of Metal Products. XVI.—A Discussion of Round Cylinder Barrels as Distinguished from Six or Eight-Panel Barrels. H. Leroy Beaver (*Products Finishing*, 1947, **12**, (3), 28, 30, 32, 34, 36, 38, 40).—Cf. *Met. Abs.*, this vol., p. 371. The need for suitable baffles in cylindrical barrels is emphasized.—G. T. C.

Barrel Finishing for Mass Production. Herbert Chase (*Metal Finishing*, 1948, **46**, (4), 56-60).—C. describes a barrel-finishing plant designed to handle parts ranging from grey-iron castings weighing about 6 lb. to small parts weighing only a fraction of an ounce. Metals treated include ferrous, zinc-base die-castings, brass, and aluminium. A table shows recommended proportions of materials used in the barrels. Brief accounts of the various types of barrel are given.—G. T. C.

XXI.—JOINING

Effective Automatic Soldering. W. R. Graham (*Machinery (Lond.)*, 1948, **72**, (1838), 78-81).—A device for soft soldering a lap joint between two cups, forming an oil filter, is illustrated and described. The assembly carried by a conveyer, is heated and pre-fluxed and is then rotated opposite a gas burner. Solder wire is fed to the joint at a suitable rate so that it is melted and flows freely. With one operator, 2200 cases are soldered in 8½ hr.—J. C. C.

Mechanized Soft Soldering. — (*Steel*, 1947, **120**, (15), 98, 123).—An automatic machine for soft-soldering 20-gauge steel boxes is described. The work is moved, at a controlled speed, under an oxy-acetylene blowpipe and an automatic solder-wire feeder.—M. A. V.

***A Study of the Behaviour of Ruthenium-Palladium in Torch Flames, with the Object of Improving Soldering Technique.** R. H. Atkinson and G. P. Gladis (*Trans. Amer. Inst. Min. Met. Eng.*, 1946, **166**, 426-434; discussion, 435).—See *Met. Abs.*, 1946, **13**, 341.—J. L. T.

The Processing of Aluminium-Steel Bonded Assemblies. M. G. Whitfield and V. Sheshunoff (*Modern Metals*, 1948, **4**, (3), 13-15).—The production of composite aluminium-steel articles by casting or brazing aluminium on to steel is described. It is thought that this process will have a wide field of application.—N. B. V.

†A Brief Review of Brazing Processes. H. R. Brooker (*Sheet Metal Ind.*, 1947, **24**, (246), 2041-2045; (247), 2253-2256; (248), 2457-2462; discussion, 2462-2466; 1948, **25**, (249), 125-128).—Presented to the Sheet and Strip Metal Users' Technical Association. Brazing materials, fluxes, joint design, technique, and examples of brazed work are discussed and described.

—R. GR.

Furnace-Brazing Steel Insecticide Bombs. Allen T. Cole and H. M. Webber (*Steel*, 1947, **120**, (4), 70-73, 110, 113-114).—Steel containers are copper brazed in an electric furnace, without flux, in a reducing atmosphere. Details of the plant, fabrication, and testing are given.—M. A. V.

How Silver Brazing May Simplify Casting Design. S. D. Heron (*Steel*, 1947, **120**, (14), 90-91, 120, 122).—The application of silver brazing to the

fabrication of grey-iron castings of complex design is exemplified by an L-head cylinder block. Some technical data on the brazing process are given.

—M. A. V.

"Musts" in Silver-Brazing Stainless [Steel]. A. W. Swift (*Steel*, 1947, 120, (17), 98–99, 132).—The methods of overcoming some of the special difficulties encountered in silver-brazing stainless chromium alloy steels are outlined.—M. A. V.

The Inspection and Testing of Brazed Joints with Especial Reference to Silver Alloy Brazing. J. L. Christie and A. M. Setapen (*Weld. J. (J. Amer. Weld Soc.)*, 1947, 26, (9), 767–770; and (summary) *Sheet Metal Ind.*, 1947, 24, (248), 2478–2479).—A résumé of testing procedure.—P. H.

Salts for Heat-Treatment [and Soldering and Brazing]. (Hague). See p. 534.

A Few Observations on Solid-Phase Bonding. George Durst (*Metal Progress*, 1947, 51, (1), 97–101).—D. discusses what is known of the various factors believed to influence solid-phase bonding, such as temp., pressure, and presence of oxide and adsorbed-gas films.—N. B. V.

Developments in Cold [Pressure] Welding [of Aluminium]. — (*Engineer*, 1948, 185, (4814), 432–433).—A general account is given of the method of pressure welding of aluminium and its alloys. Straight, ring, and tube welding can be carried out by the technique. By using special dies whose two components have different areas, copper can be welded to aluminium. Illustrations of specimen welds are given.—R. Gr.

***The Pressure Welding of Light-Alloy Bar Without Fusion.** R. F. Tylecote (*Sheet Metal Ind.*, 1948, 25, (249), 155–160, 162, 164; (250), 373–374, 376).—Presented at a British Welding Research Association Symposium on the Welding of Light Alloys. T. describes tests to determine the strength of pressure welds produced by applying a relatively high initial butting pressure, heating by means of a multi-nozzle oxy-acetylene ring, and applying an upsetting pressure when the required temp. has been reached. The materials investigated comprised a selection of aluminium and magnesium alloys representative of the range of alloys obtainable.—R. Gr.

British Welding Research Association Symposium on the Welding of Light Alloys: The Pressure Welding of Aluminium Alloys. R. F. Tylecote (*Sheet Metal Ind.*, 1948, 25, (251), 574–578; discussion, (253), 1005–1008, 1010).—Cf. preceding abstract. T. discusses the general principles and summarizes the practical information obtained on a laboratory-scale research. Suggestions are made for the practical application of the process.—R. Gr.

Lead Welding Practices. L. S. Bowser (*Weld. J. (J. Amer. Weld. Soc.)*, 1947, 26, (9), 777–781).—B. discusses the technique adopted for lead burning.—P. H.

The Welding of Aluminium-Magnesium Alloys. E. A. G. Liddiard (*Sheet Metal Ind.*, 1947, 24, (245), 1857–1860, 1862).—Presented at a British Welding Research Association Symposium on the Welding of Light Alloys. The difficulties of welding this material are considered, and recommendations are made to deal with the troubles. These involve steps to avoid contamination with impurities and to minimize gas absorption. Data are given on the mechanical properties of sound gas-welds made in the laboratory.—R. Gr.

***Aluminium Alloys for Gas Welding, with Special Reference to Aluminium-Silicon-Copper Alloys.** J. Pendleton and E. A. G. Liddiard (*Sheet Metal Ind.*, 1947, 24, (246), 2062–2066, 2068; (247), 2273–2278, 2280).—Presented at a British Welding Research Association Symposium on the Welding of Light Alloys.—R. Gr.

Discussion of Technical Papers on "The Development of Strong Aluminium Alloys for Welding". — (*Sheet Metal Ind.*, 1947, 24, (248), 2484–2488, 2490).—Discussion of papers presented at a British Welding Research Association Symposium on the Welding of Light Alloys.—R. Gr.

Flash-Butt Welding of Aluminium Alloys in Sweden. B. Anderson (*Sheet Metal Ind.*, 1948, 25, (252), 785-786, 792).—Presented at a British Welding Research Association Symposium on the Welding of Light Alloys.

—R. GR.

Examination of Light-Alloy Flash Welds Made by Aseavets, Sweden. R. F. Tylecote (*Sheet Metal Ind.*, 1948, 25, (252), 787-790, 792).—Cf. preceding abstract. Presented at a British Welding Research Association Symposium on the Welding of Light Alloys. Tensile properties were determined and other examinations made to find out whether welding had occurred by fusion or by pressure. It appeared that the welds were fusion welds by a flash-welding process.—R. GR.

The Work of the Welding Research Team at the University of Birmingham, July 1944 to January 1947. — (*Aluminium Develop. Assoc. Research Rep.*, 1947, (1), 35 pp.).—The following investigations are reported: the properties of the aluminium-silicon alloys at temp. in the region of the solidus; the hot-shortness of aluminium-silicon alloys (with particular reference to welding); the welding properties of aluminium-magnesium-silicon-manganese alloys; the hot-shortness of the aluminium-iron-silicon alloys and aluminium-copper-silicon alloys; the tensile properties of some aluminium-copper-silicon alloys; the hot-shortness of complex aluminium-zinc-magnesium-copper-manganese alloys; the welding and hot-shortness properties of the aluminium-magnesium silicide alloys; the hot-shortness of the aluminium-magnesium-silicon alloys; and the hot-shortness of the more important binary aluminium alloys. It was shown by high-temp. tensile tests that a hot-shortness range exists in the aluminium-silicon alloys and that a consideration of this range can explain their welding and casting behaviour. Binary, ternary, and some quaternary aluminium alloys have been placed in an order of "susceptibility to cracking", during casting or welding. Ring-casting and restrained-weld tests were employed; there was close agreement in the results. These tests impose a degree of restraint on the casting which is much higher than the restraint imposed on a casting or weld under normal conditions. The cracking tendencies of alloys in the ternary systems aluminium-iron-silicon, aluminium-copper-silicon, and in the pseudo-binary system aluminium-magnesium silicide conform, in general, with predictions based on the consideration of hot-shortness. Suggestions are made as to which alloys are most suitable for welding. Work by other investigators arising from the findings of the welding research team is briefly reviewed.

—J. L. T.

The Welding of Non-Ferrous Metals. VIII.—The Welding of Copper and Its Alloys. IX.—The Welding of Nickel and Its Alloys. E. G. West (*Sheet Metal Ind.*, 1947, 24, (244), 1643-1645; (246), 2058-2061; (247), 2265-2271; 1948, 25, (249), 147-154. Cf. *Met. Abs.*, this vol., p. 69. (VIII.—) Carbon-arc and metallic-arc welding are more successful for welding copper-aluminium alloys than gas welding, and these methods are described. The welding of other copper alloys, including copper-nickel and copper-beryllium, is briefly reviewed. (IX.—) The welding of nickel is referred to in more detail. The nominal compositions of nickel-base materials are tabulated. A summary is given of the application of the various processes of welding to different thicknesses of nickel-base materials. The technique of the various welding methods and photomicrographs of the joints are given.—R. GR.

The Welding of Non-Ferrous Metals. X.—The Welding of Lead and Its Alloys. E. G. West (*Sheet Metal Ind.*, 1948, 25, (251), 563-573).—Cf. preceding abstract. The conditions which have to be satisfied for satisfactory welding are considered in detail. Suggestions are given for the technique to be employed for the fabrication of various components.—R. GR.

The Welding of Non-Ferrous Metals. XI.—The Welding of Zinc and Its Alloys. E. G. West (*Sheet Metal Ind.*, 1948, 25, (252), 777–781, 784).—Cf. preceding abstract. The physical and chemical properties of zinc which influence the weldability of the metal are first discussed. Details are then given of gas welding, resistance welding, and brief reference is made to the limited use of hammer welding.—R. GR.

Welding Characteristics of the High-Temperature Alloys. C. G. Chisholm (*Steel*, 1947, 121, (26), 54–56, 58–59).—C. classifies heat-resisting alloys into (1) cobalt and cobalt–nickel base alloys, (2) nickel–base alloys, and (3) cobalt–nickel–iron base alloys, and discusses their respective welding characteristics. In most cases, any desired welding process may be used, the choice depending on available equipment.—M. A. V.

***On a Welding Process for the Joining of Sheets and Profiles of Magnesium Alloys Containing 6 and 7% Aluminium.** Walter Bulian (*Metallforschung*, 1947, 2, (7/8), 249–251).—Parts up to 10–35 mm. thick and 100 mm. wide can be joined in the following manner. The ends are shaped as if making a V-join in autogenous welding, lightly coated with flux, and placed in a mould. The ends are heated, almost to melting, with a torch, the mould filled with molten metal of the same composition, and, after cooling, the surplus metal is machined off. Such joints have tensile properties only a little lower than those obtained with autogenous welding, while the expenditure in time is much less.—E. N.

Fundamentals of Oxy-Acetylene Welding and Cutting. J. I. Banash (*Steel*, 1947, 121, (19), 110–112, 144, 146, 149).—The principles and technique of the process, and its application to various metals (mainly ferrous), are described.—M. A. V.

***Examination of Electrically Welded Structural Elements in Aluminium Alloys.** L. Huguenin (*Schweiz. Arch. angew. Wiss. Techn.*, 1947, 13, (7), 202–210).—[In German]. H. describes the results of tensile tests, fatigue tests, and metallurgical examinations of various electrically welded joints, typical of those commonly encountered in welded structures. The alloys investigated were Avional D, Anticorodal A, and Peraluman 3. Welding was carried out using a current of 110–160 amp, the component parts being preheated to 250°–300° C.; this technique yielded satisfactory welds, free from porosity, in Avional D, and Anticorodal A, when a 12%–silicon rod of 4–5 mm. dia. was employed. It was not found possible to obtain good welds in Peraluman 3; both 4%–silicon and Peraluman 5 rods were tried with this alloy. The strength properties of welded Avional D are equal or better than those of cast Silumin; welds in Anticorodal A have somewhat lower strength. Some of the tests carried out on welded cross-pieces showed that insufficient penetration of the weld metal may give rise to notch effects and consequent low fatigue strength. The fatigue limit of welded cross-pieces in Avional D was 4.1 kg./mm.² (10⁷ reversals of stress); similar tests on Anticorodal A gave a fatigue strength of about 3.0 kg./mm.² Full details and dimensions of the various test-pieces employed, are given.—R. W. R.

Recent Magnesium Developments: Electroplating Magnesium; High-Frequency Superimposed A.C. Magnesium Arc Welding; Brazing of Magnesium. (Loose). See p. 514.

***The Inert-Gas-Shielded Arc-Welding Process.** Glenn J. Gibson (*Weld. J. (J. Amer. Weld. Soc.)*, 1947, 26, (5), 282–294s).—The inert-gas-shielded arc-welding process was investigated using a specially designed electrode holder. To study the characteristics of the arc this holder was mounted on a lathe carriage, the arc being struck between the electrode and a water-cooled tube revolving in the lathe. The use of helium and argon were compared. When using helium a low current value causes erosion from the trailing side of the electrode which tends to pinch off the end of the electrode. This

condition may be remedied by increasing the current. A low current when using argon results in the formation of a small molten globule which moves round the end of the electrode and causes a crooked bead. When the current is increased the end of the electrode becomes molten and maintains a spherical shape. The arc voltage-arc length relation for argon is independent of electrode size, welding current, and gas flow, but the arc voltage in helium can be increased by increasing the gas flow and decreased by increasing the welding current. The welding characteristics were also studied. Penetration bears an almost linear relationship to energy input with similar values for both helium and argon. Less energy is required to fuse a given area when the speed of travel is high. Deeper penetration is found in a helium-shielded arc, particularly at low current values, than with the argon-shielded arc. Penetration curves rise sharply at low travel speeds, indicating that operation is less critical at high speeds. A discussion on welded joints is included, and some tensile-test results for steels and some non-ferrous metals are presented.

—P. H.

Arc Welding and Resistance Welding: Present Status as Reported by Recent Literature. P. J. Rieppel (*Metals Rev.*, 1948, 21, (2), 5-7, 9).—A review, with references to abstracts published in *Metals Rev.*—S. G.

The Approval of Electric Arc Welders. J. van Maanen (*Rev. Soudure*, 1946, 2, (2), 53-64).—An account of the regulations governing the approval of electric arc welders which have been formulated by the leading classification societies of the world.—F. A. F.

Annual Review of Electrical and Allied Developments.—Welding. — (*Gen. Elect. Rev.*, 1947, 50, (1), 26-28).—A brief report is given of outstanding welding developments in 1946. The synchronous precision resistance welding control is described and also non-synchronous control methods. An account is given of a capacity-discharge control panel for use in welding the components of electronic tubes. The following are described in connection with arc welding: a three-arc atomic-hydrogen head, a twin-unit outdoor A.C. arc welder, methods of cleaning aluminium for welding, and new electrodes for the welding of free machining steels and chrome-stabilized (0.5% chromium) steels.—D. M. L.

Considerations in Design of Weldments. George L. Synder (*Machine Design*, 1946, 18, (1), 135-142).

Manufacture of Welding Electrodes. — (*Machinery (Lond.)*, 1946, 69, (1767), 231-234).

Welding Inspection. R. G. Colvin (*New Zealand Eng.*, 1946, 1, (1), 53-58; (2), 142-144).—Presidential Address to the New Zealand Institute of Welding. Discusses the responsibilities and obligations of the welding inspector, and the problems that he is likely to meet.—S. G.

Welding and Cutting: Eighteen Months' Progress as Reflected in the Technical Literature. R. D. Williams (*Metals Rev.*, 1947, 20, (7), 5-8, 47).—Essentially a guide to abstracts published in *Metals Rev.*—S. G.

Welding Equipment: 150 New Products and Processes as Described by the Manufacturers. — (*Metals Rev.*, 1947, 20, (7), 9-11, 14-15, 17, 19).—Covers arc welding; electrode holders and accessories; resistance welding; timers, controls, and accessories; arc-welding electrodes; hard surfacing; gas welding; cutting; brazing; solders; fixtures and positioners; and miscellaneous equipment.—S. G.

New Welding Equipment: Manufacturers Announce 127 New Products and Processes in Past Six Months. — (*Metals Rev.*, 1948, 21, (2), 11, 13, 15, 17, 19).—S. G.

A Survey of Established Processes for the Jointing of Metals [—I, —II, —III]. D. F. Hewitt (*Sheet Metal Ind.*, 1948, 25, (250), 363-366, 372; (252), 771-776, 782; (253), 991-994, 1004).—(I.—) H. deals with soft soldering

from the technical point of view. Reference is made to the soldering of aluminium. (II.—) The principles and practical details of the various methods of jointing are discussed. Sweat, machine and silver soldering, and brazing by various methods are described. Hints are given on the design of suitable joints for brazing. (III.—) The fusion welding of components by gas and arc welding is considered from the point of view of technique.—R. GR.

Factors Affecting the Choice of Metal-Joining Processes. J. L. Miller (*Sheet Metal Ind.*, 1947, **24**, (246), 2051–2057, 2061).—The scope and limitations are considered of the various joining processes, including riveting, soldering, brazing, and welding. Some applications are discussed.—R. GR.

The State of Advancement of Knowledge Pertaining to Welding in the U.S.A. at the End of 1945 [—I, —II, —III].—La Motte-Grover (*Rev. Soudure*, 1946, **2**, (2), 72–86; (3), 121–128; (4), 172–178).—A version of a report prepared by M.-G. for the Institut Belge de la Soudure. (I.—) Largely concerned with ferrous parent materials and electrodes. (II.—) Though dealing mainly with ferrous materials, touches on some questions of general interest, including chamfers and machine chamfering, machining of joints, and weld sequence. (III.—) Contains a number of errata in the first two parts. The remainder is devoted to questions of residual stress, the avoidance of thermal stresses, and the control of distortion.—F. A. F.

The Versatility of Scientific Welding. C. W. Brett (*Tin Printer*, 1947, **23**, (268), 10–11).—S. G.

The Basic Principles of Resistance Welding and a Description of Some Modern Machines [—I]. C. E. Slade (*Sheet Metal Ind.*, 1948, **25**, (253), 995–1004).—Presented to a Joint Branch Meeting of the Institute of Welding. An elementary review of the subject.—R. GR.

Three-Phase Balanced-Load Resistance-Welding Machines. J. L. Solomon (*Weld. J. (J. Amer. Weld. Soc.)*, 1947, **26**, (5), 426–431).—S. G.

Electronic Control of A.C. Resistance-Welding Machines.—I, —II. B. G. Higgins (*Machinist (Eur. Edn.)*, 1947, **91**, (5), 137–141; (6), 171–175).—Electronic control equipment has a wide range of application in the field of A.C. resistance welding. H. describes the types of valves used, the basic form of controls, and gives details of the methods of timing, the application of the phase shifting, and some special controls.—S. G.

[Discussion on H. E. Dixon's Paper:] **"Some Fundamental Principles for the Resistance Welding of Sheet Metal."** E. G. West. F. A. Fox (*Sheet Metal Ind.*, 1947, **24**, (245), 1853–1856).—Cf. *ibid.*, (239), 607–617, 624; (240), 813–820; (242), 1221–1226, 1230; (243), 1430–1435; *Met. Abs.*, this vol., pp. 71, 119.—R. GR.

Riveting and Spot-Welding Magnesium Alloys.—VI. Allen G. Gray (*Steel*, 1947, **120**, (9), 114–115, 142, 144, 146, 148, 150, 152, 154).—Cf. *Met. Abs.*, this vol., p. 540. A general account of technique.—M. A. V.

Joining Magnesium Alloys.—VII. Allen G. Gray (*Steel*, 1947, **120**, (10), 90–91, 114, 116, 119).—Cf. preceding abstract. Details are given of recommended technique for gas, arc, and flash welding, and soldering (using Cd–Zn or Cd–Zn–Sn soldering alloys).—M. A. V.

Multiple-Head Welders. — (*Electronic Ind. and Instrumentation*, 1947, **1**, (11), 12).—A 1000-kVa. peak-capacity spot welder for joining two thicknesses of 11-gauge sheet for but fabrication is described. Eleven separate welding heads are employed, each of which is a complete machine in itself. Automatic adjustment for electrode-tip wear is provided on each hydraulic cylinder.—D. M. L.

Plastic Bonding: Wood-to-Metal and Metal-to-Metal Joints in Aircraft Construction. Charles J. Moss (*Aircraft Prodn.*, 1948, **10**, (113), 87–89).—A description of the Redux process for the bonding of metal to metal, metal to wood, and metal to phenol-formaldehyde plastics. In all three cases the

bond is resistant to the action of alcohol, acetone, carbon tetrachloride, cold or boiling water, petrol, paraffin, lubricating oil, and hydraulic fluid. It is not susceptible to fungus growths and does not deteriorate with age. Components to be bonded are first degreased and any surface oxide film is removed. Aluminium and aluminium alloys are cleaned chemically with a mixture of chromic and sulphuric acids (D.T.D. 915). The Redux liquid resin is brushed on to the metal and a white powder is sprinkled on to the resin. The bonding operation is then carried out at a minimum temp. of 140° C. and a pressure of approx. 200 lb./in.² for approx. 15 min. Main advantages of bonding over riveting are: (1) greater strength, (2) bonded joints more economical, and (3) the skin surfaces are aerodynamically clean and not spoiled by rivet heads.—W. A. M. P.

Engineering with Rubber. J. P. Lawrie (*Rubber Develop.*, 1947, 1, (1), 12-18).—Deals with rubber-metal bonds.—S. G.

XXII.—INDUSTRIAL USES AND APPLICATIONS

The Nineteenth Exhibition [at Paris] of Agricultural Machinery [Uses of Aluminium Alloys]. Maurice Victor (*Rev. Aluminium*, 1947, (132), 137-145; and (abridged translation) *Modern Metals*, 1948, 4, (1), 30-32).—A description is given of agricultural machines and equipment in which aluminium alloys are used: it is well illustrated.—F. A. F.

[Aluminium Alloys in] Small Boats. — (*Aluminium Courier*, 1948, (3), 3-4).—Brief notes on the use of aluminium alloys in small-boat building, from a holiday toy paddle-boat to a patrol cruiser used for policing the coast of Nova Scotia for the Royal Canadian Mounted Police.—W. A. M. P.

Introduction of Aluminium Building Wire Overcomes Copper Shortage—Light Metal Also Found Practical for Other Electrical Cables. — (*Wire and Wire Products*, 1947, 22, (4), 282).—J. C. C.

New Uses for Aluminium—Application as Busbars, Wire, Conduit, and Cable Sheathing; Economic Factors; Use of Aluminium Alloy Castings. — (*Elect. Eng. Merchandiser*, 1948, 24, (11), 353-354).—S. G.

Aluminium-Sheathed Electric Cables. — (*Engineering*, 1948, 165, (4291), 404).—The insulated core is threaded through a pre-extruded seamless tube of commercial-grade aluminium. This tube is then swaged to form a closely fitting sheath. The characteristics of the product are enumerated and compared with those of the normal lead-coated cable.—R. Gr.

Use of Aluminium for Cable Sheathing. — (*Light Metal Age*, 1947, 5, (11), 25).—A digest of report PB78274: Fabrication of Aluminium in Germany, issued by the Office of Technical Services, Dept. of Commerce, Washington, D.C. In addition to the subject indicated by the title, it covers the recovery of aluminium from aircraft scrap, and various fabricating processes.—M. A. V.

Aluminium-Sheathed Power Cables. — (*Engineer*, 1948, 185, (4813), 398-399; (4814), (422-423).—Some of the characteristics of aluminium-sheathed cables, and the methods of jointing and terminating, are described.—R. Gr.

Light [Aluminium Alloy] Cartographic Camera. — (*Modern Metals*, 1948, 3, (12), 22-23).—Aluminium alloys, chiefly in the form of castings in No. 108 alloy, are extensively used in the aerial mapping camera described.—N. B. V.

Aluminium in Can Making. T. Fielding (*Tin Printer*, 1947, 23, (273), 7-9).—S. G.

Cast Aluminium Cooking Utensils (Metal Composition). — ([*U.S.*] *Nat. Bur. Stand., Commercial Stand.*, 1946, (134-46), 10 pp.).—Covers the com-

position of the metal, and methods of test therefor, of cast aluminium utensils designed and intended for use in the cooking of food.—S. G.

The Use of Aluminium in the Dairy Industry. Pierre Prévot (*Rev. Aluminium*, 1947, (132), 121–128).—A well illustrated review is given of dairy applications. The solubility of aluminium of 99–99.5% purity in sterilized milk is not detectable; proper anodizing protects it against attack by lactic acid. The materials used are 99.5% aluminium, or alloys of the Mg_2Si , or of the aluminium–magnesium type. For parts in direct contact with milk, the Mg_2Si type of alloy is not suitable.—F. A. F.

From Co-Ordinated Research to Commercial Development [Uses of Aluminium]. — (*Overseas Eng.*, 1947, 21, (238), 22–24).—The history, constitution, and aims of the Aluminium Development Association are presented. Descriptions and illustrations are given of an all-aluminium railway and road bridge, a hostel-type aluminium house, a ship's lifeboat in Birmabright alloy, a light-alloy ship's navigating bridge, an aluminium alloy crane jib, and an aluminium-lined fish-hold.—R. L. B.

Aluminium at the 36th Paris Fair. — (*Rev. Aluminium*, 1947, (134), 205–217).—S. G.

Aluminium for Farm Equipment. — (*Modern Metals*, 1948, 4, (1), 19).
—N. B. V.

Cast [Aluminium] Electrical Hardware for High-Tension Lines. — (*Modern Metals*, 1948, 4, (2), 36).—Cast aluminium clamps are superior to galvanized iron and steel ones for aluminium cables, as they eliminate magnetic heating and electrolytic corrosion.—N. B. V.

Urbanism and Housing [Uses of Aluminium]. Maurice Victor (*Rev. Aluminium*, 1947, (136), 275–286).—An account is given of an international exhibition with the title “Urbanism and Housing”, held in Paris. Aluminium was advocated by some exhibitors for roofing, guttering, and rain-pipes, as well as for window-frames, walls, and for some furnishings.—F. A. F.

Reynolds Broadening Aluminium Markets. — (*Modern Metals*, 1948, 3, (12), 30–32).—A review of current applications of aluminium and its alloys in the United States.—N. B. V.

[Aluminium Die-Castings in a] Rayon Motor : Operation in an Acid Atmosphere. C. L. Hamm and J. S. Boudreau (*Die-Castings*, 1947, 5, (12), 21, 45–46).—H. and B. describe a vertical-spindle induction motor, which includes four aluminium die-castings, for use in the production of rayon filament.—P. L.

[Aluminium in] Radio Receiving Sets. Jacques Piget (*Rev. Aluminium*, 1947, (136), 265–269).—An account is given of the use of aluminium in the construction of radio receiving sets.—F. A. F.

Aluminothermics [Uses of Aluminium as a Reducing Agent, with Liberation of Heat]. H.-C. Gonon (*Rev. Aluminium*, 1947, (132), 117–120).—A survey is made of processes in which aluminium acts as a reducing agent on a metallic oxide, with the liberation of heat; thermit welding and repair is the subject mainly dealt with.—F. A. F.

New Portable Rig Has Safety and Light Weight [Use of Aluminium Alloys]. Nicholas A. D'Arcy (*Petroleum Eng.*, 1948, 19, (6), 225–226, 228).—An oil-well drilling rig is described which is constructed partly of aluminium alloy plate, sections, and castings. The rig is mounted on a trailer in which widespread use of aluminium alloys has also been made with the object of reducing weight.—G. T. C.

Large Aluminium Roofing Installation. — (*Modern Metals*, 1948, 4, (1), 14–15).—The Mormon Tabernacle at Salt Lake City has recently been re-roofed using 3S- $\frac{1}{2}$ H aluminium alloy sheet. The roof is in 188 sections which were accurately preformed before installation.—N. B. V.

Wrought Aluminium Sink. — (*Light Metals*, 1947, 10, (117), 495-497).—Cf. *Met. Abs.*, this vol., p. 374. An account is given of the installation and behaviour of a sink of aluminium-2% magnesium alloy, in a private house. After twenty months' service, examination showed it to be in perfectly satisfactory condition.—F. A. F.

Aluminium Trim, Channel, and Weather Strip. — (*Modern Metals*, 1948, 4, (1), 26).—N. B. V.

Selecting Aluminium Alloys for Specific Applications. (Dobkin). See p. 501.

New [Aluminium] Automatic Washer. — (*Modern Metals*, 1948, 4, (2), 24-25).—The washing machine described is built almost entirely of aluminium and its alloys.—N. B. V.

Light Metals [Applications]. R. J. Lund and C. M. Craighead (*Eng. and Min. J.*, 1948, 149, (2), 82-85).—A comparison is given of the prices of aluminium and magnesium with those of other metals. The changing uses of aluminium are briefly reviewed. It is estimated by one manufacturer that 100,000 more cars could be produced per year by replacing 120 lb. of steel with aluminium on a car. The largest single use of aluminium in the automotive industry is stated to be the aluminium piston. The high cost of wrought magnesium products compared with steel is attributed to the small scale of operation, causing the cost to be six to ten times that for fabricating steel by mass production and good engineering practice.—R. Gr.

Some Engineering Problems of [in the Use of Light Alloys in] Large Aircraft. A. E. Russell (*J. Roy. Aeronaut. Soc.*, 1947, 51, (434), 145-170; discussion, 170-196).—R. discusses, *inter alia*, the material problems and relevant matters. The greatest scope for weight saving by material control is in the light-alloy sheets used, and slightly less in the light-alloy extrusions. Light-alloy parts may amount to 75% of the aircraft-structure weight. Specified mechanical properties do not give the designer the information he needs, notably the average strength, the average dimensions, and the scatter about the mean. Light alloys produced by different manufacturers to the same specifications differ more widely from each other and from the specification than is the case with steels. A rejection rate of 24% is considered by R. to be a small price to pay for the corresponding increase in structural efficiency realizable by discarding material that is slightly below the desired standard. For large aeroplanes it is often possible to work to higher stresses, lower tolerances, non-standard thicknesses, and larger sizes than normal, with a handsome saving of weight as the reward.—H. S.

Light-Alloy Developments at Kaiser-Frazer [Automobile Works.] Clay P. Bedford (*Modern Metals*, 1948, 4, (2), 17-19).—Kaiser-Frazer have been investigating the possibility of extended applications of light alloys in their automobiles. Promising developments include sheet-aluminium petrol tanks, magnesium wheels, and die-cast aluminium door frames, instrument panels, and deck-lids.—N. B. V.

Light Alloys in the Internal-Combustion Engine [—IV, —V, —VI]. C. R. Draper (*Light Metals*, 1947, 10, (116), 450-455; (117), 542-548; (118), 552-560).—Cf. *Met. Abs.*, this vol., p. 374. Light alloys lend themselves for use as cylinder blocks on account of their good machinability and thermal conductivity. Light-alloy sumps are now much used and there is a good case for the wider use of light-alloy connecting rods. Light-alloy pistons are discussed at length from the points of view of design, working characteristics, and wear. Magnesium alloy pistons have been tried, but were not successful. "Y" alloy is still in the front rank of piston alloys, but materials of the R.R. 53 type are increasingly used, as well as aluminium-silicon-nickel-copper-magnesium alloys such as "Lo-ex"; less-usual piston-alloy compositions are also discussed. Causes of piston failure are touched upon, and

this leads to a discussion of surface-treatment processes, such as anodizing, tinning, lead or cadmium plating, or graphitizing. Piston-production problems, such as porosity, distortion, and internal stress are touched upon.

—F. A. F.

The Development of the Goblin Engine [Use of Light Alloys]. E. S. Moulton (*J. Roy. Aeronaut. Soc.*, 1947, 51, (440), 655–678; discussion, 678–685).—The large light-alloy impeller is made in R.R. 59 and is machined from a solid cheese of about 500 lb. weight. Final heat-treatment is effected when the machining has been taken within $\frac{1}{8}$ in. of finished dimensions. A large dimple at the back of the impeller and a hollow boss provided are beneficial in the quenching operation. Curvature of the vanes is achieved by machining. Later impellers have been made in low-silicon R.R. 59 (silicon 0.25% max.). The minimum acceptance properties at any point in the impeller are: ultimate stress 24 tons/in.², 0.1% proof stress 16 tons/in.², elongation 6%. In low-silicon alloy impellers produced from continuously cast ingots these minimum properties have been handsomely exceeded. Every impeller is subjected to overspeed test. M. refers to turbine-disc cooling and the advantages of ferritic types of steel for a cooled disc. The moving blades are made in Nimonic 80 and the static blades in G 18 or Nimonic 75.—H. S.

Instructions for the Use of Light Alloys in Machinery. H. Hugonnet (*Machines et Métaux*, 1947, 31, (351), 361–367).—M. E.

The Thirty-Fourth Motor Show [Uses of Light Alloys]. Maurice Victor (*Rev. Aluminium*, 1947, (139), 365–381).—An account is given of the “Salon de L'automobile” held in Paris. Many exhibits were prototypes, not yet in production. Two cars are especially notable for the extensive use of light alloys—these were the Dyna-Panhard and the Georges Irat; the latter had a magnesium chassis and was shown stripped down after having run 82,000 km., being still in perfect condition. Many details are given of materials used in the construction of the different models exhibited.—F. A. F.

[Light Alloys] In the Service of Science [—II, —III, —IV]. — (*Light Metals*, 1947, 10, (116), 443–448; (117), 536–539; (118), 576–580).—Cf. *Met. Abs.*, this vol., p. 375. A review is continued of the laboratory uses of aluminium. The thermal properties of the metal make it suitable for the construction of calorimeters and thermostat elements, and the electrical properties for spark-gap spheres and for high-voltage generators. Aluminium, being non-toxic, may be used for vessels to contain solutions and ferments in the biological laboratory. Aluminium or aluminium alloy foil is useful for microphone diaphragms for special acoustic instruments, an application in which its corrosion-resistance also helps. This latter property leads to the choice of aluminium also for many out-door applications, such as for polar-expedition equipment, as well as for indoor fittings in the chemical laboratory. The low specific gravity accounts for the use of aluminium in scientific instruments in which suspensions are critical, or where portability or low inertia are important. Aluminium wire or foil filament-type flashlights are also useful in the laboratory.—F. A. F.

[Uses of] Minor Metals: Antimony, Arsenic, Beryllium, Bismuth, Cobalt, Cadmium, Mercury, Platinum Metals, Titanium. Charles White Merrill. Richard H. Mote. Alan F. Matthews. Hubert W. Davis. Helena M. Meyer (*Eng. and Min. J.*, 1948, 149, (2), 86–89).—The production and consumption figures of the minor metals in the United States are given. References are made to changes in particular applications, such as the possibility of greater consumption of mercury if the new dry cell develops according to promise. Although the jewellery trade is the greatest consumer of platinum, in the year 1947 the demand was 36% less than in 1946, and total consumption was about 11% smaller, at a figure of 172,000 oz.—R. Gæ.

Plain Sleeve Bearings, Materials and Design. W. H. Tait (*J. Inst. Prod. Eng.*, 1947, **26**, (3), 75-92; discussion, (4), 111-125).—A good general account of the service requirements of lubricated sleeve bearings and of the fields of application of commercially available bearing materials.—J. C. C.

Hard Carbides Find Non-Cutting Uses. Philip M. McKenna (*Machinist (Eur. Edn.)*, 1946, **90**, (36), 1453-1456).

New Developments in Tungsten Carbide [Use in Punches and Dies]. (Zapp). See p. 539.

Columbium Metal Assumes Importance. F. H. Cothay (*Tin*, 1948, (Feb.), 3-4).—Some uses of the metal are discussed, particularly the marked improvement in the physical properties of high-grade steels obtained by the addition of 1.0-1.2% columbium.—P. L.

[Uses of Copper and Its Alloys]. — (*Copper and Brass Bull.*, 1947, (142), 16 pp.).—Illustrates uses of copper and its alloys in ships, transport, tunnels, sewage plant, and industrial meters, and for miscellaneous engineering applications.—S. G.

[Uses of Copper and Its Alloys]. — (*Copper and Brass Bull.*, 1948, (143), 16 pp.).—Illustrates uses of copper and its alloys in the home, hotels, departmental stores, interior decoration of steamships, in offices and banks, and for various decorative effects.—S. G.

Modern Uses of Hard Metals. H. Burden (*Alloy Metals Rev.*, 1948, (47), 2-11; and (abridged) *Metallurgia*, 1948, **38**, (223), 27-33).—M. A. V.

Power Installations [Use of High-Temperature Alloys]. F. M. Owner (*J. Roy. Aeronaut. Soc.*, 1947, **51**, (434), 71-105; discussion, 105-108).—O. refers briefly to the call for improved materials to withstand higher temp. and operating speeds in gas-turbine engines. Research work will be necessary for the production of suitable ceramic materials for blades. As an intermediate step, hollow turbine nozzle blades and rotor blades with air or liquid cooling will be developed. High-temp. alloy castings for turbines necessitate the development of new foundry technique to obtain the necessary accuracy and thin sections.—H. S.

[Uses of] Lead. Robert Lindley Ziegfeld (*Eng. and Min. J.*, 1948, **149**, (2), 79-80).—The United States lead supplies and consumption for 1946 and 1947 (estimated) are tabulated. Demands showed a very high requirement for lead batteries. Conditions have stimulated substitution in the cable, paint, and tetra-ethyl lead industries to a limited extent. Before the war, foil absorbed 4 or 5% of the total lead consumed, was almost prohibited for use in packaging during the war, and has now been largely substituted by aluminium.—R. GR.

***Use of Molten Lead as Quenching Medium in Carbothermic Production of Magnesium.** P. P. Zapponi and M. J. Spendlove (*U.S. Bur. Mines, Rep. Invest.*, 1947, (4082), 4 pp.).—In small-scale exploratory tests on the use of molten lead for quenching the magnesium-carbon monoxide vapours formed by carbothermic reduction of magnesium oxide, approx. $\frac{2}{3}$ of the magnesium was recovered as a lead alloy containing up to 1% magnesium. The results of the tests indicate that the use of lead as a quenching medium is promising.—S. G.

Lithium. Ch. More (*Machines et Métaux*, 1947, **31**, (346), 206-209; (347), 247-250).—A bibliographical study of the uses and properties of lithium.—M. E.

Use of Magnesium in Aircraft. — (*Light Metal Age*, 1947, **5**, (6), 6-7).—A brief review of the operations carried out in the U.S.A. by the Glenn L. Martin Company in fabricating magnesium alloy sheet and extrusions.—M. A. V.

XXIV.—BIBLIOGRAPHY

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XXV.—BOOK REVIEWS

Magnesium. By L. M. Pidgeon, J. C. Mathes, N. E. Woldman, J. V. Winkler, and W. S. Loose. A Series of Five Educational Lectures on Magnesium Presented to Members of the A.S.M. during the Twenty-Seventh National Metal Congress and Exposition, Cleveland, O., February 4-8 1946. Med. 8vo. Pp. v + 265, with 118 illustrations. 1946. Cleveland, O.: American Society for Metals, 7301 Euclid Ave. (\$3.50.)

Each of the five lectures printed in this volume constitutes a separate section: the longest, of 88 pp., is that on corrosion; castings and wrought alloy fabrication have 64 and 62 pp., respectively, extractive metallurgy 22 pp., and structural design 24 pp.

In the section on extractive metallurgy Professor Pidgeon remarks that "the metallurgy of magnesium is still in that interesting pioneer stage where a number of different methods have operated side by side with reasonable success". The alternative methods of producing anhydrous magnesium chloride for electrolysis are described: dehydration of $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, due to the Dow Chemical Company, and direct production by reaction of MgO with carbon and chlorine, as operated by I.G. Farbenindustrie and Magnesium Elektron, Ltd. Direct-reduction methods employ carbon (Hansgirk Carbothermic), calcium carbide (Murex), aluminium-silicon (International Alloys), and ferro-silicon (Pidgeon and Electro-metallurgical Corporation). The author is at pains to be fair in his comparison of the merits of the various processes, in spite of his special interest in one of them. He makes the legitimate claim that the distillation processes yield a magnesium of higher purity than electrolytic processes, but agrees that—on war-time records—the Dow electrolytic process showed by far the lowest operating costs. His conclusion is that it may be that no single method will triumph, but one may be most suitable in one location and a different method in another. Thermal and electrolytic zinc provide an established analogy.

Mr. John C. Mathes (Development Engineer, Magnesium Division, Dow Chemical Company), author of the section on "Magnesium Structural Design", calls attention to the dearth of published information on allowable stresses in ordinary structural design, due to the preoccupation of suppliers with the needs of the airplane designer. The difference between the two cases, as Mr. Mathes explains it, is that aircraft designers at proof load are stressing their materials to the yield strength, and anticipate occasional stresses of this magnitude in service, whereas the designer who wishes to follow structural steel practice uses working stresses which include a nominal safety factor. To make good some of the deficiencies in these directions the author provides tables of safe working stresses for magnesium alloys on bending, shear, and bearing, based on normal practice in structural steel. Possibilities of weight saving by substituting magnesium alloys, cast and wrought, for cast iron, steel, and aluminium alloys in various types of service are shown quantitatively. An informative section deals with I-beams, round solid, and tubular columns, giving detailed comparisons between magnesium alloys, steel, and aluminium alloys. A special consideration in this connection is that in most wrought magnesium alloys the yield strength in compression is less than in tension. In applications requiring limited flexibility the need for making allowance for the lower modulus of elasticity of magnesium is well recognized. The chapter concludes: "Proper consideration of the mechanical properties of magnesium will result in a design lighter than is possible with any other metal combined with satisfactory and adequate serviceability".

The section on Magnesium Castings by Dr. Norman E. Woldman (Chief Metallurgical Engineer, Eclipse-Pioneer Division, Bendix Aviation Corporation) covers familiar ground in its treatment of foundry processes, but there is much valuable specific information. An example in connection with sand castings is that an average of about 4-5 lb. of magnesium alloy must be poured for each pound of trimmed casting, whereas in aluminium alloys, the ratio is almost 3 lb. of metal poured to 1 lb. of casting. The titles of some of the sub-sections indicate the scope of the treatment: foundry practice, heat-treatment, composition and properties, characteristic uses of castings, defects, metallography, machinability, welding, impregnation, and finish. Dr. Woldman asserts that it is difficult to produce pressure die-castings free from cracks in the standard alloys and commends, in their place, new compositions with only 1-1.5% aluminium. This makes curious reading, in view of the considerable production in this country of pressure die-castings in the standard alloy containing 9% aluminium. It is disappointing to find no reference to means other than superheating for grain-refinement, e.g.

the use of carbon and carbon compounds. Another notable omission is the failure to mention the zirconium-containing alloys.

The "Survey of Wrought Magnesium Alloy Fabrication", by Mr. J. V. Winkler (Dow Chemical Company) summarizes current American practice in shaping and forming magnesium alloy sheet and strip. The well known considerations leading to 230°–360° C. being the preferred range for working are set out, and a very full account is given of the alloys available, cutting methods, presses, drawing and forming dies, pre-heating ovens, lubrication, and drawing technique (temperature, holding pressure, draw speeds). Recent practice is described in rubber forming, bending sheet and extrusions, and stretch forming. With reference to spinning, one manufacturer claims that he can hot spin any shape from annealed *M* (1.5% manganese) or *FS1* (3% aluminium, 1% zinc) alloy that can be spun from pure aluminium sheet. Joining methods include spot welding, riveting, gas welding, arc welding, bonding cements, and resistance flash welding. Comparing helium and argon as the inert gas in arc welding, it is stated that both have been found satisfactory. About three times more helium by volume than argon is consumed for a given amount of welding. Helium does not require as close an arc length as argon, and is therefore somewhat easier for the welder to use. The automatic voltage regulator on an automatic welder does not function when argon is used. With helium the regulator is satisfactory and welding may be fully automatic. Residual stresses as high as 15,000 lb./in.² may exist in areas near arc-welded heads. A schedule of stress-relieving treatments is given ranging from 15 min. at 260° C. for annealed sheet of all compositions to 1 hr. at 130° C. for hard 3% aluminium, 1% zinc alloy.

Mr. W. S. Loose (Metallurgist, Dow Chemical Company), in his lecture on "Corrosion and Protection of Magnesium", first shows how misleading are the tests in which magnesium alloys are immersed in salt water. Magnesium alloy canoes were still in excellent condition after 10 years' service in Michigan, but when a sample of the sheet was submitted to the common 3% sodium chloride alternate-immersion test it disintegrated in 16 hr. The author attributes this difference to the large potential differences caused by the impurities in common magnesium alloys when placed in salt water, which is an exceptionally good electrical conductor. In order to assist in the difficult task of interpreting laboratory data in terms of service performance, Mr. Loose discusses special factors operating in different types of action, e.g. aqueous media, soil, non-aqueous media, atmosphere, galvanic corrosion, stress corrosion, corrosion fatigue, and high-temperature corrosion. There is a full and clear statement of the critical tolerance limits for iron and other impurities in various alloys, based on the work of Hanawalt, Nelson, and Peloubet.

The whole volume provides a remarkable store of information and exposition on most, though not all, of the important aspects of magnesium technology. Each of the lectures must have been received with pleasure when it was delivered, and the account now presented will be read with profit by all concerned, as users or producers, with magnesium and its alloys.

—A. J. MURPHY.

Metallurgy. By Carl G. Johnson. Third edition. Demy 8vo. Pp. viii + 418, with numerous illustrations. 1946. Chicago: American Technical Society (\$5.00); Kingston Hill, Surrey: Technical Press, Ltd., Gloucester Road (30s.).

The third edition of this book by the Assistant Professor of Mechanical Engineering at Worcester Polytechnic Institute, U.S.A., is intended for those working in industry, and for students of engineering in trade and technical schools. Its 16 chapters deal with the manufacture and properties of all types of iron and steel, and with bearing metals, light alloys, and copper alloys. Physical metallurgy is taken as the viewpoint, but presumably because of the limited objective, only 16 lines are devoted to X-rays and only two pages to considerations of space lattices. The various equilibrium diagrams of binary alloys are briefly dealt with, and the illustrations of microstructures are numerous and satisfactory. References are given for most of the illustrations, but not to points arising in the text. In consideration of the methods of teaching employed in many U.S. schools, each chapter concludes with about twenty "quiz questions".

The volume may certainly be recommended as a text-book of metallurgy for engineers. One must criticize, however, the omission of any reference to corrosion fatigue and creep, and the tensile test is too briefly dealt with. There is a whole chapter on powder metallurgy, but only one page on welding. The corrosion of metals is touched on, and it is stated that "one of the most generally accepted tests is the salt-spray test". The term "hardenability" is not included in the index, but two pages are devoted to the Jominy test.

At the end comes a glossary of terms, which should be useful for the student. Some of the definitions will not suit everybody: thus "overheating" is said to be heating to the zone of incipient fusion, and the structure of a normalized steel is called the normal structure. Some guidance is given regarding technical literature: "For metallurgy, as well as for other engineering subjects (my italics), books are available . . ." and "Various metallurgical

journals contain accounts of recent advances . . ." In the list of ten important journals which follows, only one of them is British. It is very sad; the *Journal of the Iron and Steel Institute* is there alright, but we find no trace of the *Journal of the Institute of Metals*! Does this mean that our *Journal* is not considered to be sufficiently practical?

—HUGH O'NEILL.

Le Polissage Électrolytique des Surfaces Métalliques et ses Applications. Tome I.—Aluminium, Magnésium, Alliages légers. By P. A. Jacquet. 26.5 × 21 cm. Pp. xiii + 359, with 355 illustrations. 1948. Saint-Germain-en-Laye (S. et O.): Editions Métaux, 32 rue du Maréchal Joffre, (3600 francs.)

A detailed account is given in this book of the development, technique, and applications of the electrolytic polishing of metals. It is being issued in two volumes, the first dealing with aluminium, magnesium, and their alloys, while the second, not yet published, will cover all other metals, and will deal more extensively with the theory of the process. The present volume is divided into four parts. Part I (pp. 1–72) describes the methods used for polishing light alloys. For aluminium-base alloys, Jacquet's own method (perchloric acid–acetic anhydride) naturally receives the fullest treatment, but the description of the de Sy–Haemers method, and of others using different electrolytes, is adequate. One chapter is devoted to processes for magnesium-base alloys. In every case, information is given about the apparatus needed, and recommendations made for pre-treating the specimen and for operating conditions. This is generally supplemented by a brief account of the investigatory work which led to the adoption of the conditions specified.

Part II (pp. 73–152) deals with various investigations on electrolytically polished metals. It covers measurements of reflectivity, solution potential, and hardness, and describes work on corrosion, diffusion, electron diffraction, electron microscopy, and plastic deformation. It contains one chapter on the formation, structure, characteristics, and defects in the anodic film.

Part III (pp. 152–300) deals with the microstructure of cast, worked, annealed, and heat-treated light alloys. For each alloy, optimum polishing conditions are specified, and a description given of the phases present and of other structural features. That electrolytic polishing is unrivalled for revealing the finest details of the structure, and for use in tracing the initial stages of recrystallization and precipitation, is clearly demonstrated by the superb photomicrographs, of which some 200 are included.

Part IV (pp. 301–319) contains a description of the Brytal and Alzak processes, in which highly reflecting surfaces are obtained by some degree of electrolytic polishing followed by the imposition of a transparent anodic film.

The book can be thoroughly recommended, not only as a work of reference, but for day-to-day use in laboratories in which micrography is used, or in which investigations are proceeding on the structure or behaviour of metals of which the surfaces are free from deformed layers and oxide films.—H. W. L. PHILLIPS.

The Science of Dental Materials. By Eugene W. Skinner. Third edition, revised. Med. 8vo. Pp. vii + 410, with 155 illustrations. 1947. Philadelphia and London: W. B. Saunders Co. (30s.)

This third edition of an excellent book is to be greatly welcomed. The reviewer has not seen a copy of the second edition, but, in comparison with the first one which was published in 1936 (see *Met. Abs.*, 1937, 4, 575, for review), there have been considerable changes both in the contents of the chapters themselves and in their arrangement. From the metallurgist's point of view the book has been brought up to date.

It is interesting to note that in the present edition two chapters on synthetic resins replace those on vulcanite for denture base materials; otherwise the subjects in the book are in the main similar to those in the first edition. The Appendix has been enlarged and now consists of 12, instead of 8, A.D.A. specifications.

The author is very modest, for on p. 227 he refers to the abrasion studies by Lasater; on looking up the reference one sees that there are two names, the first of which is the author's.

This book should be invaluable to those interested in dental materials.—M. L. V. GAYLER.

Chemical and Electroplated Finishes: The Protective Treatment of Metals. By H. Silman. With a Foreword by H. Moore. Demy 8vo. Pp. xiii + 414, with 131 illustrations. 1948. London: Chapman and Hall, Ltd. (30s. net.)

A comprehensive picture is presented in a readable form of a wide range of commercial processes for the finishing of metals by wet treatments. Nearly one-half of the space is devoted to electroplating and one-third to the preparatory processes of pickling, polishing, and cleaning

of metals, which may be common to many finishing treatments; metal colouring, "decorative and light-duty finishes", which include phosphate coatings, and methods of finishing aluminium and magnesium alloys are also included, and there is an introductory chapter giving a broad account of modern views on the corrosion of metals. The chapters on electroplating plant and on polishing and cleaning are especially commendable. The book is clearly arranged and well illustrated; it is printed on good paper and is provided with both author and subject indexes. Selected references to important publications on the subjects dealt with are added at the end of each chapter.

The book is not intended as a complete guide to the processes described for it does not include methods of controlling them or of remedying defective coatings. There is a short chapter of 13 pp. on the testing of protective finishes, but the factors governing the performance of such coatings in service are not comprehensively described. The author has succeeded remarkably well in giving a very fair picture of the chemical principles involved in the processes described, although, since lack of space has generally prevented more than a superficial treatment of the scientific background, the specialist will find points of detail which merit criticism. The book can, however, be confidently recommended as giving an admirable account of modern practice in "wet" metal finishing in a particularly well informed and up-to-date manner.

—A. W. HOTHERSALL.

Leichtmetallanalyse. By H. Ginsberg. Zweite, neu bearbeitete und erweiterte Auflage. Pp. xx + 427, with 27 illustrations. 1945. Berlin: Walter de Gruyter and Company, Woyrschstrasse 13, W. 35; Oslo: Reistad and Sonnes Boktrykkei. (25 kroner.)

The author describes gravimetric, volumetric, colorimetric, electrolytic, polarographic, and spectrographic methods for the analysis of aluminium, beryllium, and magnesium and their alloys, and of the raw materials used in their production. Each method is described in the sequence: principles, procedure, and additional explanatory notes where these are needed. There are useful marginal cross-references, a convenient index, and an adequate bibliography of literature available in Germany during the war. The chemical methods are orthodox, and the physical techniques are given less prominence than their present importance in this country would warrant. The handbook is useful chiefly because it summarizes and provides a key to German practice. Experienced analysts in the respective fields covered will find little that is new and some details of procedure that could be altered in the interests of accuracy or speed; less specialized workers will find much that is helpful.

Methods for the following determinations are described: in aluminium and its alloys, Al, Ca, Cd, Co, Cu, Cr, Fe, Mg, Mn, Na, Ni, Pb, Sb, Si, Sn, Th, Ti, V, Zn, Zr; C, CO, CO₂, CH₄, H, N, O, P, S: in beryllium and its alloys, Al, Be, Cu, Fe, Ni, Si, Ti, and Zr: in magnesium and its alloys, Ag, Al, Ca, Cd, Ce, Cl, Cu, Fe, Pb, Mn, Na, Si, Sn, Zn, Zr, and nitride. In the section of the book dealing with the analysis and testing of fluxes, alumina, and other raw materials, methods are given for determining Al₂O₃ and SiO₂ in Baeyer liquor; F in AlF₃, Al, F, SiO₂, and Na in Cryolite, aluminium fluoride, and fluoride fluxes; SiO₂, Fe, Al₂O₃, Ca, and BaSO₄ in fluorspar; Be in beryl; Cl in MgCl₂; SiO₂, Fe, Na₂O, Ca, and Ti in calcined alumina; water, ash, volatile, and electrical conductivity of cokes; ash, volatile softening point, and the pyridine, anthracene, and benzol soluble fractions of pitches.

The aluminium section contains a useful chapter on rapid quantitative and qualitative analysis.—T. G. PEARSON.

Wood Patternmaking: A Text-Book. By Herbert J. McCaslin. Fourth edition, second impression. Cr. 8vo. Pp. xxviii + 366, with 409 illustrations. 1946. New York: McGraw-Hill Book Co., Inc. (\$2.50); London: McGraw-Hill Publishing Co., Ltd. (16s.).

Mr. McCaslin has primarily written this very useful book for those desiring to follow the occupation of patternmaking and for others interested in the elementary principles of the art. First published in 1923, this fourth edition has been substantially enlarged and brought up to date. The text is divided into two parts. Part 1, entitled Bench Work, gives a detailed outline of the methods employed for the construction by hand of some 31 designs of typical patterns and core-boxes used in the foundry. Part 2, headed Lathe Work, covers the construction of a further 30 designs requiring turning operations in addition to hand work.

The arrangement of the book is excellent, if unorthodox, as it contains no chapters, but is sectionalized by job and pattern numbers as used in industrial practice. Greater prominence might have been given to the question of standard pattern colours, and future editions would undoubtedly be improved if the colour plan as recommended by the American Foundrymen's Association, and as adopted in Great Britain, could be included as an illustration. Written in a clear and concise manner and well illustrated, this book should appeal to the practical worker and will serve a most useful purpose in the training of foundry as well as pattern-shop apprentices.—FRANK HUDSON.